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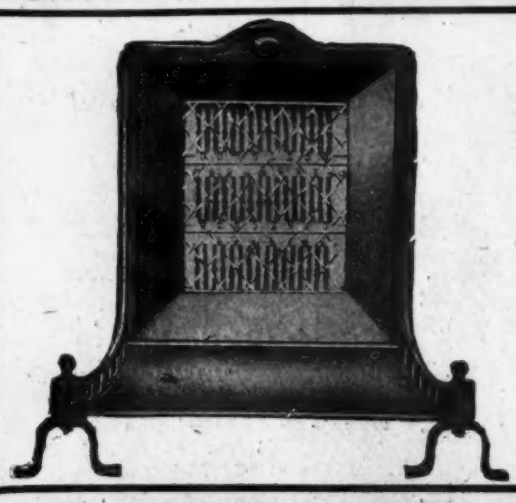

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Index to the Electrical Review,
July 2nd, 1920.

THE

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE OLD YEAR AND THE NEW.

THOUGH it is not our intention to occupy the time of the reader, or to tax his already over-burdened mind, with a detailed review of the events of the year that has just closed, the occasion cannot be passed over without brief reference to some of its outstanding problems and experiences. Nineteen-nineteen has passed into history, and it will be remembered as one of the most momentous years through which any of us has lived.

Many anxious months were occupied with the negotiating of the Terms of Peace; even now the Treaties have not been ratified by all the parties concerned therein, and there yet remain unsettled many World Problems arising in that connection. The demobilisation of millions of men has been continuously in progress, and the British Empire and the Allies have been faced with innumerable difficulties attending the resettlement of the Forces in peaceful avocations. While we have been thus engaged, there have crowded in upon us the accumulated problems of five years of war; these and other matters all seemed to clamour at once for settlement. Though our hands were as full with duty directly connected with the war as at almost any period of actual hostilities, the weight of responsibilities was added to enormously by a desire that was abroad for all the ills of humanity to be removed without delay as by the waving of some magic wand. Nationalisation demands, incessant agitations for higher wages and shorter hours, efforts to secure "control," the railway strike and struggle with the community, the continued increase in the cost of living, the serious developments in rates of exchange, the ever-growing burden of National Finance—these are some of the leading questions of the year. Remembering all that has been involved, and all the dangers through which we have passed, it is impossible to view the situation in its entirety without adopting the tone of optimism of the King's Speech. It is a matter for general thanksgiving that we have passed through so critical a year without greater damage to constitutional and individual interests.

Limiting our survey to matters coming more immediately within the scope of our specialised activities, we recall that for thousands of factories and works no inconsiderable part of the period referred to has been busily occupied with the turnover from war work to commercial production. For some concerns this was naturally an easier operation than for others. During the year it was possible to reveal something of the brilliant war-time record of engineering and electrical factories, of the achievements of scientific men and societies, of the advances in wireless applications, and of the exploits which stand to British credit in submarine telegraphy.

Electrical, engineering, and other scientific bodies have returned to former activity; indeed, are more "live" than ever. The I.M.E.A. and the B.A. have resumed their pre-war programmes. The Whitley Councils are taking shape, and as a result of this movement the E.P.E.A., the S.T.E., the N.A.S.E., and the E.S.C.A. have been stimulated to increased activity with a view to securing the representation of their members—the "middle class" of the industry—on the Councils.

If we turn our thoughts to purely electrical operations, perhaps we must place first and foremost the Electricity Supply Act, which has just received the Royal Assent.

Our pages have told from week to week, as the year has passed on, of gratifying projects which were in course of preparation. Electric railway work is about to advance on a large scale within the United Kingdom, in the Colonies and Dependencies, and in practically all parts of the world. There are hydro-electric schemes ready to be put in hand at

home and abroad. In wireless and cable telegraphy and telephony, land and sea alike, conditions are ripe for a great move forward. Electricity works in all parts of the kingdom are short of plant, and cannot keep pace with the demand for energy, notwithstanding all the additions of the war period. The domestic load and all that that implies is promising beyond our fondest hopes of earlier days. The Electrical Development Association is getting to work at the right moment. The electric vehicle is coming into its own, as the numerous orders of the year have proved. The outlook for manufacturers in all departments of the industry is unquestionably brighter than it ever has been.

At the beginning of 1919 we wrote looking forward to a period of intensive activity in the electrical industries. If we were justified then we are more than justified to-day, for it is our conviction that the electrical industries are in for a Boom, and for one that should last for years if the menace of industrial unrest and financial stress do not assume serious shape. In a sense, we have carried over to 1920 many of the problems that we had to meet in 1919, but the experience of the latter year fills us with hope.

Dartmoor in Danger?

THE proposal to develop the possibilities of Dartmoor as a source of water-power has aroused the wrath of those who love the district for its æsthetic amenities and its archæological interest, and they are conducting an energetic campaign against the scheme by letters to the Press. We respect their feelings, and their solicitude for the interests of those who, they say, would suffer injury if the scheme were carried through. But are they justified in believing that those natural features or those interests would be prejudiced by the utilisation of the waterpower?

The details of the project are not in our possession, but they are not necessary to our purpose, which is to point out that hydroelectric works do not *consume* the water which passes through their turbines, nor do they contaminate it in any way. The water is still available for use in irrigation or for human consumption when it has yielded up its energy, and by the construction of dams and reservoirs its flow is regulated so that floods and droughts are obviated. At the same time the benefit of a supply of electric power at their doors will accrue to the residents, and the district will be enabled to develop industries without the accompaniment of smoky chimneys, while many thousand tons of coal will be annually saved.

Whether scenic beauties should be preferred to industrial development in these days is a question upon which we hold very decided views, but in this case we doubt whether that question arises at all. A much more weighty objection to the proposal is one to which Mr. H. Davey has given definite shape—namely, the extravagant expenditure which is foreshadowed, and which appears to be out of all proportion to the output obtainable. The chief obstacle to the development of water-power is usually the question of finance, and if the scheme will not hold water from that point of view it is not likely to float.

"Where Angels Fear to Tread."

WHILST uttering a solemn protest against the Dartmoor scheme, on the usual lines—that is, taking for granted that it would necessarily ruin the district as a pleasure resort, which is an unwarranted assumption—the *Daily Mail* does not scruple to give pictorial publicity to a hare-brained scheme emanating from the imagination of a Mr. A. E. Steel, who proposes to generate electricity by means of pumps, water tanks, and turbo-dynamos from the passage of heavy traffic over the street surface. To characterise such a proposal as idiotic is to put it mildly; moderate language is utterly inadequate to the occasion. Yet this preposterous idea is said to be "among the most ambitious inventions of the year," and the *Daily Mail* has evidently taken it quite seriously.

Now, of what value is the opinion of a paper which could entertain such a mad notion, with regard to any engineering or physical question whatever?

We regret to say that the *Morning Post* was similarly fooled, and said the scheme seemed to be "worthy of consideration." We would gladly save our lay contemporaries from these astounding blunders if they would only ring us up and ask our advice.

Stations or Super-Stations.

IT is regrettable that political considerations should be allowed to colour, or at least give a "complexion" to, purely engineering problems. That of super-stations is a case in point. The word has become a party cry. There are the super-stationists and the anti-super-stationists. The latter comprise mainly the reactionary element who profess to pin their faith to the somewhat indefinite process called "linking-up" (which the Board of Trade Electric Power Committee, with perhaps unnecessary gentleness, put aside as not in itself sufficient).

This "sit-still" party has, indeed, a good deal to answer for in giving such a good case for the Government to insist that only the most drastic steps in legislation (*vide* the Electricity Bill as it left the Commons) would be of any use. On the other hand, the word super-station has been exalted by the other party to a sort of fetish. It has stolen some of the etymological glamour attaching to the Nietzschean "super-man." As a matter of fact, there is no real distinction between a station and a super-station. The whole question, the purely engineering question, falls under two heads—one, the problem of concentrating as much plant as possible under one roof; the other, that of making the size of each machine as big as possible. The first question is only one of degree as compared with the practice in existing stations of making one roof cover as many machines as are necessary for a particular district. As to the size of the sets, here again "super-sets" are not something special and unadaptable to existing stations—witness Manchester and its 30,000-KW. set.

The fault of the whole thing is, in fact, largely due to the matter being considered *in vacuo*. There is no question of some universal panacea. Each district with its own special electrical conditions must be dealt with individually. What size of station is, in the individual case, necessary, and what size of set is most economical, under the particular conditions, must be determined by engineering considerations with due regard to the commercial aspect of the question.

German Restrictions on Dumping.

A DECIDED feeling is growing in Germany against the export of various kinds of manufactures at dumping prices in paper marks, examples of this kind being regarded in many circles as a waste of national wealth under the existing circumstances of the heavy depreciation of the mark. In pre-war times many foreign customers became so accustomed to purchasing goods from Germany—goods produced in bulk, and safely protected in the inland market by high import duties—at very low prices, that they consider it only right and proper that they should be able also at the present time to procure similar goods from Germany on the same terms, with the additional advantage of deriving benefit from the low exchange value of the mark. But the representatives of some of these customers have been afforded an opportunity of experiencing the truth of the old saying that even a worm will turn. The first instances of this kind of any importance were recorded at the recent Trade Fair held at Frankfort-on-Main, when the paper mark was still worth twice as much as it is now, and when foreign customers expressed surprise that many German exhibitors refused to accept orders for delivery in German paper exchange, but demanded payment in foreign currency, or in marks of the equivalent amount.

A second instance occurred some weeks ago, when the former Secretary of State to the Ministry for Economy, in

the course of an address delivered before the Association of German Engineers at Berlin, recommended that engineers should at once increase prices by 300 per cent.—a suggestion which was received with applause by the members of the audience—and at that time, too, the mark was substantially higher than at the present time. Since then the Association of Machine Tool Makers, in the course of a circular distributed privately among the members, advised the latter to raise prices by 700 per cent., this percentage including an increase of 300 per cent. already previously in operation. Leading iron and steel makers are also moving in the direction of obtaining in export markets prices which are practically equivalent to the world's market prices, although a decided leakage of goods sold by merchants continues to take place through the "gap" in the West. In addition, the Government is devoting attention to the waste of national property by dumping, and is determined to stop this practice either by the imposition of export duties, or by extending the control of the export trade to self-governing combinations in the form of duly authorised trade syndicates, and it is probable that the latter remedy will be adopted. Nominally the export and import trade has been under Government control for a long time past by means of the export departments for specified industries, but evasions are easy and numerous; and it is therefore thought that if each branch is self-governed by its own constituents, they will take care that merchandise is not exported at dumping prices which, while being of temporary benefit to the individual manufacturer, are detrimental to the interests of the community, which lie in the direction of securing higher export prices, and thus contributing towards an improvement in the trade balance of the country and consequently in the value of the mark.

As bearing upon the question, we observe in a Copenhagen newspaper, of December 21st, that Danish purchasers of metal goods in Germany have recently found it impossible to secure delivery, as they have been informed by German makers that the State Export Department will not grant an export permit unless the prices are increased by up to 800 per cent. In the case of a Danish importing firm which ordered electrical articles from a wholesaler in Berlin, the prices of the goods which were ordered in September were raised by 45 per cent. in October; but in the middle of November the intimation arrived that the German Government would not permit the export of the articles without the prices being more than doubled.

It is understood that similar instances have arisen in Great Britain. Whatever views we may entertain concerning the advisability or otherwise of importing merchandise of any kind from Germany, at all events we have an interest in seeing German export prices rise considerably beyond their present level. Higher prices imply a reduction in the severity of German competition due to dumping; they indicate a tendency towards an improvement in the German exchange. They show a possibility of the country being able to purchase raw materials more cheaply; and they exhibit a movement towards a manufacturing revival. If these effects are not brought about, the possibility of the Allies ever receiving a monetary war indemnity from Germany will be exceedingly remote.

Fuel Economy.

IN our "Correspondence" columns to-day, "Economy" strikes a true note; the elimination of waste of every kind—including waste of human labour—should be our aim. But the question is a very wide one, and, while we endeavour to promote economy in new ways, we must not neglect methods which are already known to us.

"Economy" rightly deprecates controversy between gas and electrical men, and we had no desire to embark upon it. But a campaign was opened by Sir Dugald Clerk, last spring, in the interests of the gas industry, in the course of which he made statements with regard to the relative merits of gas and electricity from the economical point of view which could not be allowed to pass unchallenged. So long as he affects to compare electrical energy—energy which is directly available for use, far more widely available, in fact, than if it were in the form of actual units of heat—with the potential heat energy which is admittedly present in gas, but which is not capable of utilisation to a degree even remotely approaching that of electrical energy—he is laying a false scent, and his assertions must be fought and refuted. It was for that reason that we published Mr. Klemens's articles, which we believe to be substantially true.

But, as we have said, it is a broad question, and a consideration of the first importance in this relation is almost invariably ignored—namely, the coal itself. Gas suppliers must have coal of a certain kind and quality to work upon; but there are vast quantities of coal from which the by-products cannot be extracted on an economic basis, and which are fit for nothing at all but combustion. This coal can be, and is, utilised by electricity works; otherwise it would be almost wholly wasted—thousands of tons have been dumped in the sea, and large quantities have been left in the pits. Hence, even if the claims of the gas engineers were justified, the case would not be materially altered. Put it this way: Every ton of waste coal used in electricity works saves a ton of good coal that would otherwise be used in gas works. How does the "comparison" stand then?

The Chairman of the A.E.G. Speaks Again.

DR. WALTER RATHENAU, addressing the shareholders at the recent annual meeting of the A.E.G., did not appear to be in a very happy frame of mind, judging from the reports of his speech published in the German newspapers, although he concluded by again emphasising the indispensability of German industry and trade to other countries. He stated that the destruction of property, which was a consequence of the world war, had not ceased with the end of the war, but still continued to-day. A reduction in all visible capital property was taking place, and at the same time there was a decrease in the workmen's efficiency, together with the diminution in the length of the working shift from nine to eight hours. The present low rate of production was inadequate to cope with the problems which the future imposed on world economy, and one of the chief matters of the near future was the restoration of the East and of the North of France and Belgium.

The chairman proceeded to say that, generally speaking, the balance-sheet of world economy was very gloomy. In former times the production was able to meet the consumption, but the conditions were now reversed. Still, it was impossible to refer to a period of high prosperity, as the efficiency had abated as compared with former times. If German industry wished to recover its leading importance in the world's markets, it must be guided in the direction of combination and simplification of working, and for this purpose the A.E.G. had taken up the lamp business with the Auer Co. and the Siemens & Halske Works. A great need of capital had been manifested for the entire German industry owing to the depreciation of money; the A.E.G. had contracted a loan of 100,000,000 marks, and hoped in this way to have sufficient liquid funds without provisionally holding out the prospect of an increase in the share capital.

Coming to consider the question of raw materials, the chairman remarked that at the beginning of the year, lists were prepared by private firms, and by the competent authorities, showing the classes and quantities of raw materials which would be urgently required by the industries in the next few years. The Government, however, had given way to the pressure of wide circles, and permitted free trading for many economic branches. In his opinion the dumping of German goods abroad and the fall in the value of the mark were due to this "dictatorship of free trading," whilst the keeping open of the German frontiers had also been injurious to German economy. It was urgently necessary again to promote the technical efficiency of German industry, and the speaker concluded that when this level of efficiency had again been reached, other countries would also perceive that the world's markets could not manage without German industry and trade.

THE PRODUCTION OF HYDROGEN AND OXYGEN BY ELECTROLYSIS.

By Lieut.-Col. T. A. ROSS, A.M.I.E.E., late R.A.F. and R.E.

HYDROGEN and oxygen were employed in large and ever-increasing quantities by the various Expeditionary Forces during the course of the war, and were obtained from various sources. The needs of the B.E.F., in France, of course, overshadowed all other demands.

Hydrogen was required for dirigible and observation balloons, for carrying propaganda literature by means of free balloons, and for meteorological purposes, whilst oxygen was required for treating medical, particularly asphyxiating and other gas, cases, for pilots of aeroplanes, and for workshop needs. Both hydrogen and oxygen were employed in other ways, which must, for the present, at any rate, remain secret.

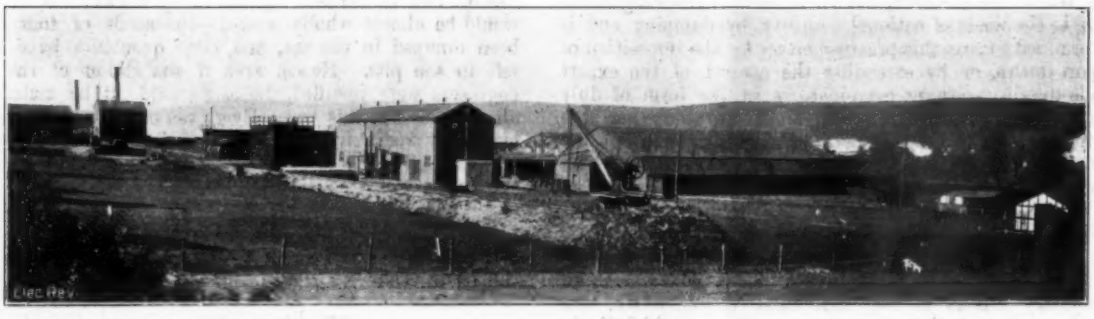


FIG. 1.—GENERAL VIEW OF THE ELECTROLYTIC WORKS.

With the processes of production, or the sources of supply, of these gases up to the latter end of 1917, this article is not concerned. It is sufficient to say that the quantities delivered fell short of the demand and that, with the programme ahead of the British Army, combined with the effects of the enemy submarine campaign, bold measures and rapid execution had to be undertaken in the field to overcome present and future difficulties.

After a survey of the situation it was decided that the production of hydrogen and oxygen by the electrolysis of water was possible in the field, and, taking every disability into consideration, promised the least delay in erection of plant. It will be appreciated that the case presented some features which are not, and never will be, present in civil operation. There were comparatively few existing data to go upon, the workshops of the Allies were more than fully occupied already, and many considerations had to be subordinated or dismissed in view of the need for speed. Nor could the attentions of the enemy by land or air be overlooked. In viewing, then, the means adopted and hereafter described, these points must receive consideration.

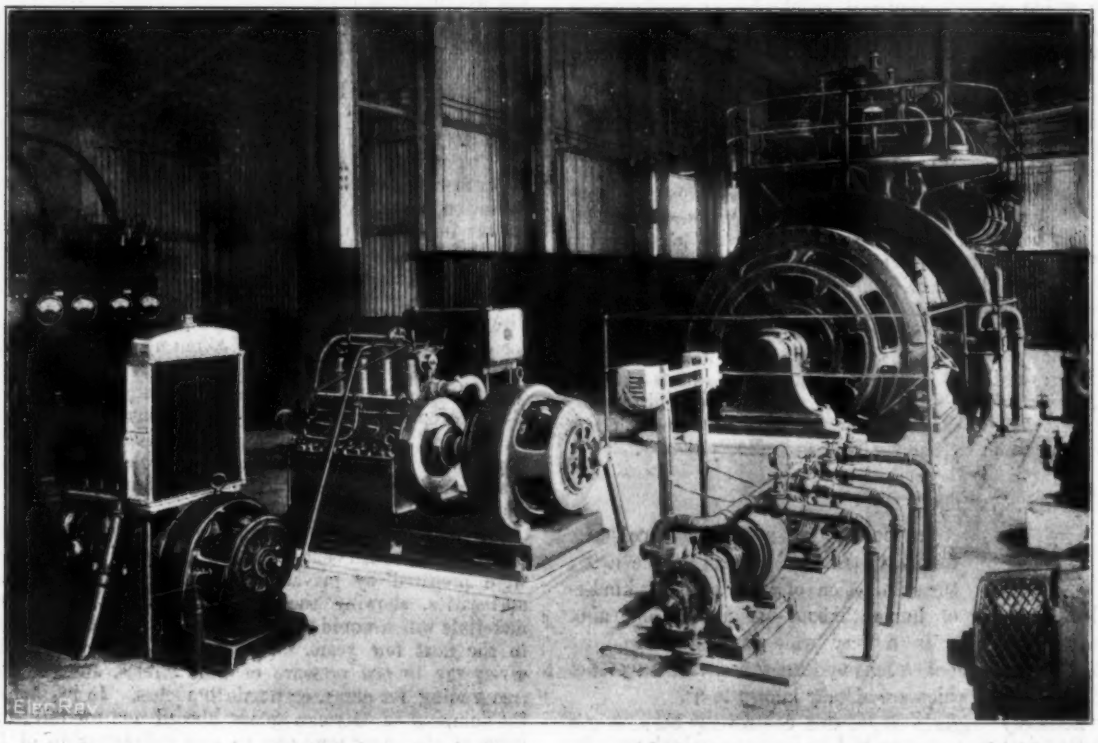


FIG. 2.—INTERIOR OF GENERATING STATION.

From many places in France and England suffi-

cient, if not always suitable, plant was gathered together in February, 1918, to form two widely separated installations in France. The combined installations were estimated to be capable of producing approximately 200,000 cubic feet of hydrogen and 100,000 cubic feet of oxygen each day of 20 working hours. These figures did not represent the total demand, but sufficient to secure the situation only.

Work on both sites was commenced early in February, but most of the effort was, for the time being, concentrated on the southern, and smaller, installation.

Work on buildings, foundations, railways, and water supply was already well advanced when, on March 21st, the German offensive was launched. Prior to that date, bombing operations by the enemy had been somewhat active, but not sufficient to lead to any modifications in the plans.

With this great and progressive offensive, however, all went into the melting pot. Such plant as could be removed was at once taken back to a place of greater safety, though it may be said here that the German wave never quite reached either site.

Eventually, the northern plant was handed over to the Admiralty for erection in England for purposes of its own, and a fresh site was selected for the remaining plant, in France, at Rouen. This is the plant now completed and described below, the plant in England not having been completed.

The site is on a slope of about 1 ft. in 40 ft., and in the lay-out regard was paid to the utilisation of this feature as far as possible. The plant may be considered as consisting of three groups, the first dealing with the production of electric power, the second with the conversion of water into hydrogen and oxygen, and the third with the storage, compressing, and handling of these gases when produced.

In principle the arrangement is that all liquids and solids flow or move by gravity down hill, and all gases travel back uphill.

Power Group.—The general arrangement is shown in fig. 4, and fig. 1 gives a view of the plant.

Buildings.—A steel-frame building houses the power plant, and was designed to be walled by sand-bagging between stanchions, and to have concrete traverses, for protecting the machines against flying splinters. It was also made long and narrow so as to reduce the target offered.

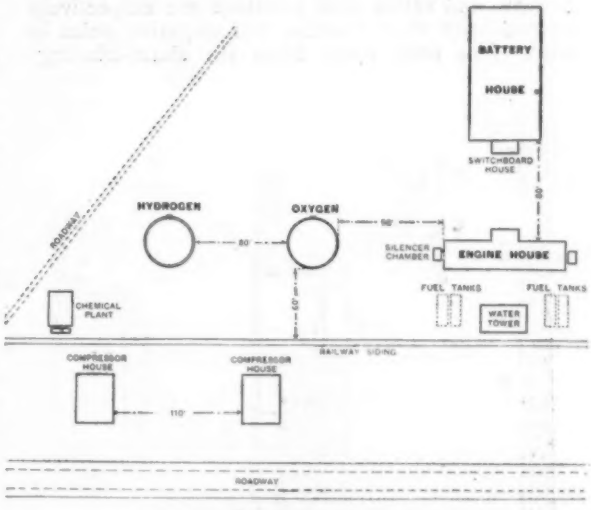


Fig. 4.—Arrangement of Plant.

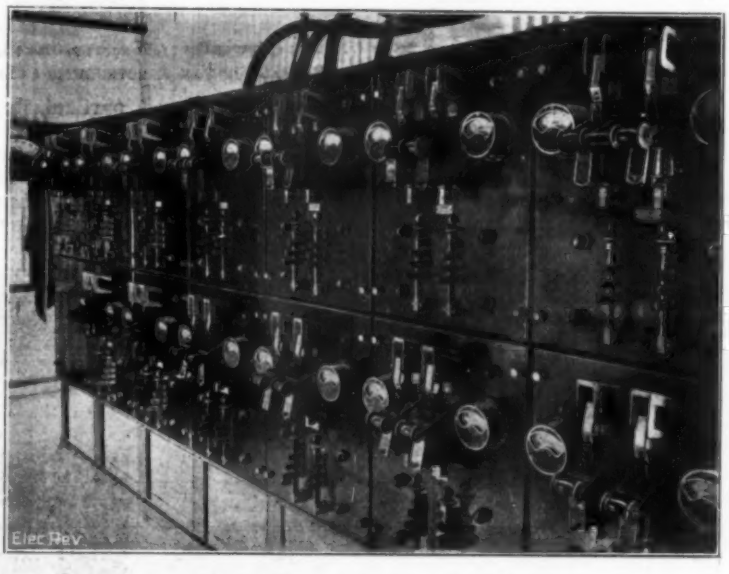


Fig. 5.—Distribution Switchboard.

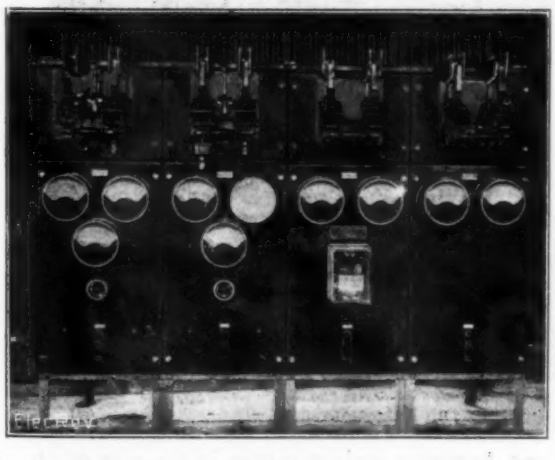


Fig. 3.—Main Switchboard.

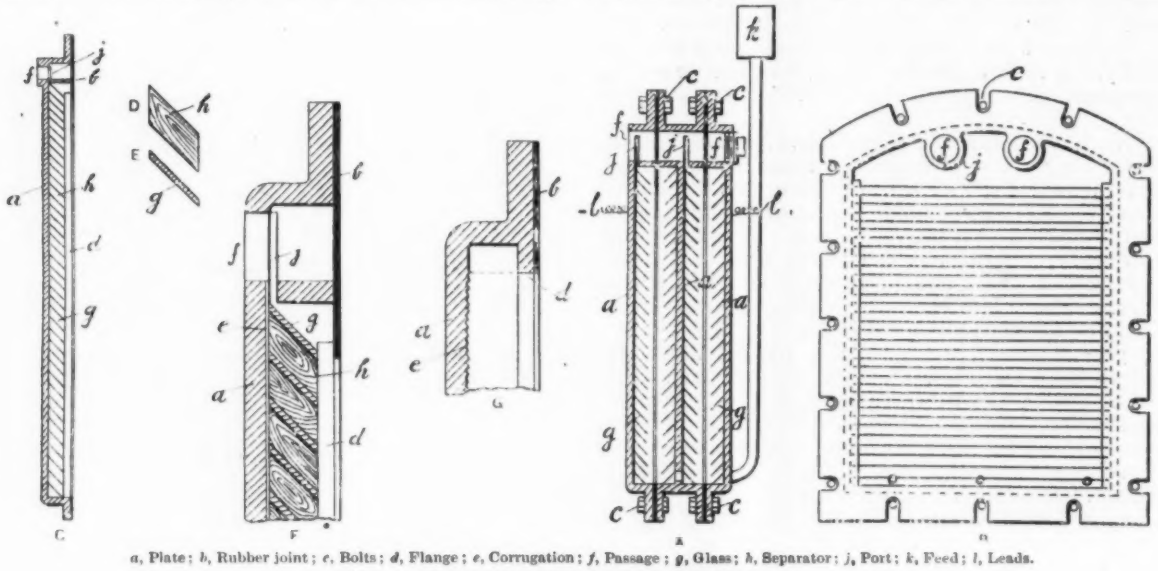
Water Supply.—After examination of the geological strata, it was decided to sink a bore-hole of 200 ft., and employ the air-lift system. This proved entirely successful, as a continuous supply of 9,000 gallons per hour is available. The water is of very good quality.

Cooling Tower.—This tower is of the usual drip-board, open-frame type, and was designed to deal with 11,000 gallons of water per hour.

Fuel Oil Tanks.—The tanks are each of 6,500 gallons capacity, and are set at such a level that the oil-fuel, on arrival in railway tank-trucks, flows into them by gravity. They are cross-connected, to ensure continuity of supply. From them the oil is pumped into two ready-use tanks of 500 gallons each, situated on platforms in the power-house.

Engines and Generators.—Two 500-550-B.H.P. Diesel engines, by Mirrlees, Bickerton & Day, drive two 340-KW. compound, interpole D.C. generators, with their windings arranged for static balancing, by Messrs. Crompton & Co., Ltd. (see fig. 2). The voltage is 480, and this is utilised on the ordinary 3-wire system, the out-of-balance load being cared for by two oil-immersed static-balancers, by Johnson and

Phillips. These balancers are connected to their respective generators through slip-rings, the armature winding being tapped at three points, and the interpole and series field windings are respectively grouped with their positive and negative poles in series. The field, apart from the shunt-winding, thus becomes divided between the positive and neutral and negative and neutral.



a, Plate; *b*, Rubber joint; *c*, Bolts; *d*, Flange; *e*, Corrugation; *f*, Passage; *g*, Glass; *h*, Separator; *j*, Port; *k*, Feed; *l*, Leads.

FIG. 6.—DETAILS OF THE ELECTROLYTIC CELLS

In dealing with the engine auxiliary gear, all starting-air receivers were interconnected and air-piping duplicated where necessary, so as to minimise the effects of possible damage by bomb-splinters.

A small auxiliary air-compressor, driven by a 4-B.H.P. petrol engine, is provided to recharge a starting cylinder in case of complete loss of air. This proved very useful.

Specially large silencers, built of soft bricks, were provided for the Diesel engines, it being the writer's previous experience that anti-aircraft gunners in the neighbourhood of engines with noisy exhausts invariably demand that they shall be shut down during raids owing to the difficulty of locating aircraft by sound under the circumstances. This is particularly the case with multiple-engined aeroplanes, which more readily synchronise with local noises. The writer had some interesting experiences at the front in this connection. In fine moonlight weather, when bombing was active on both sides, loss of production, consequent upon frequent shut-

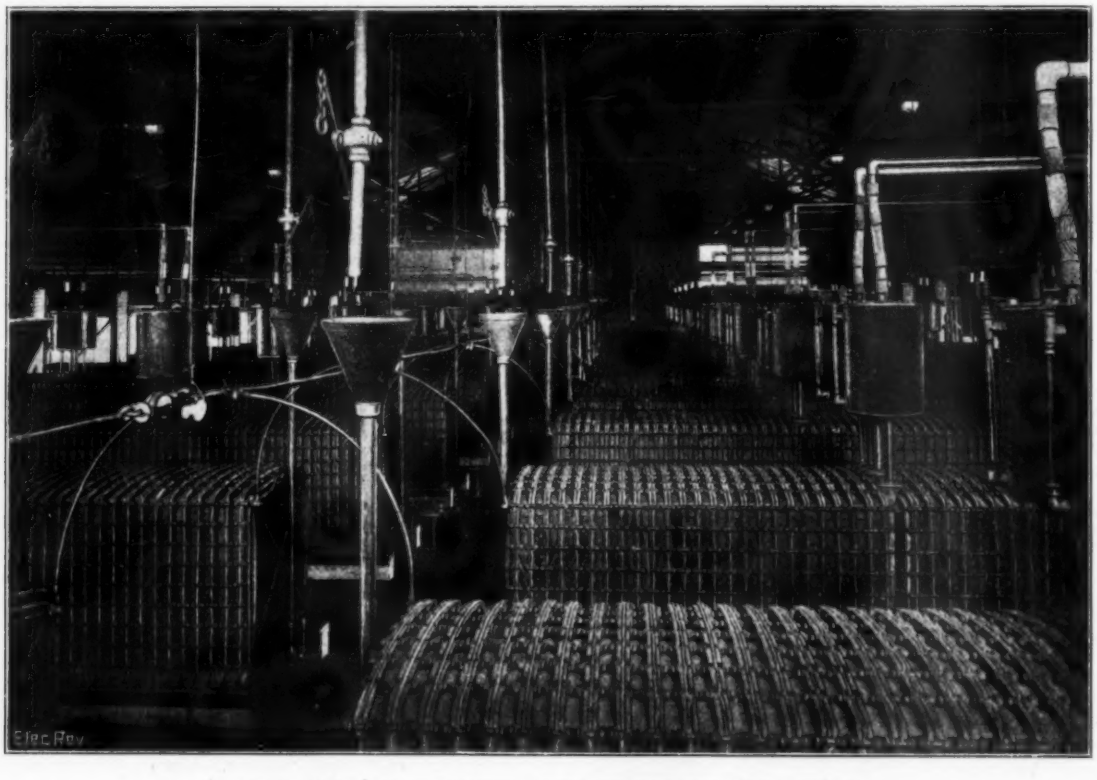


FIG. 7.—INTERIOR OF BATTERY HOUSE, SHOWING THE ELECTROLYSERS.

downs, became a serious matter in the case of certain water-treatment plants in France.

Auxiliary Machinery.—Petrol sets of 18 KW. and 5 KW. provide power and lighting at 110 volts. Two centrifugal pumps, submerged below the level of the

cooling tower reservoir, supply water for all purposes, including an auxiliary circulating-water supply to the Diesel engines after the latter have been shut

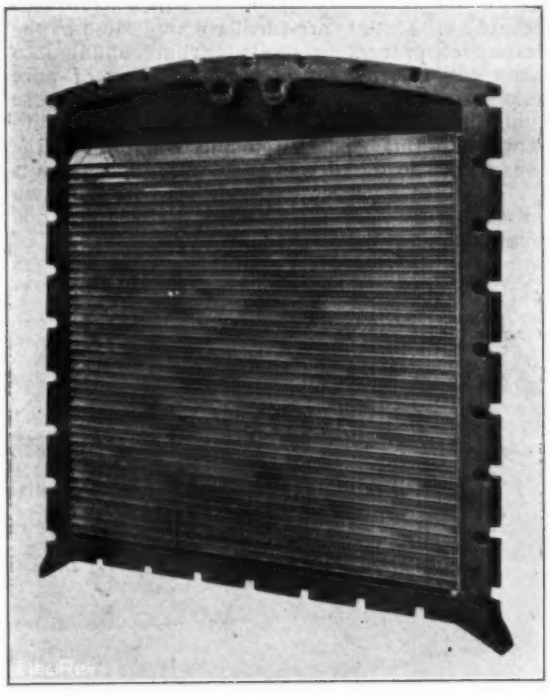


FIG. 8.—CORRUGATED PLATE WITH GLASS VANES.

down. This is to minimise deposition in water jackets.

An air compressor, motor-driven, supplies air for the air-lift system, previously referred to, and was also employed for tools during the erection of the plant.

Switchboards. — Two switchboards, seen in figs. 3 and 5, were supplied by Messrs. Switchgear and Cowans, Ltd. They present no unusual features, and were placed in annexes to the main building, in order to make their protection from bombs an easier matter. The distribution board, fig. 5, had also to be isolated from the battery house in order that flashes might not fire any escaping gases.

Gas-production Group. — The electrolytic cells, of which there are 2,600, are arranged in 52 groups of 50 each, and four groups each are connected in series between positive and negative, with the mid-way point connected to neutral, which, in turn, is earthed. A general view of the interior of the battery house is seen in fig. 7. The electrolyte is a solution of pure caustic soda dissolved in distilled water, of a specific gravity of 30 deg. Beaumé. The action of these cells, which were made on the "Système Geeraerd," can best be followed by a reference to the diagram in fig. 6. It will be noticed that this system does away with the use of a porous screen between the oxygen and hydrogen compartments, thus considerably lowering the internal resistance.

Each cell consists of two dished cast-iron plates (*a*) insulated from each other by a rubber joint and held together by a number of insulated bolts. The faces of these plates are finely corrugated. Placed horizontally across them, for their full width, and held in place by suitable ebonite distance-pieces, are a number of glass vanes (*g*). Referring to fig. 6F,

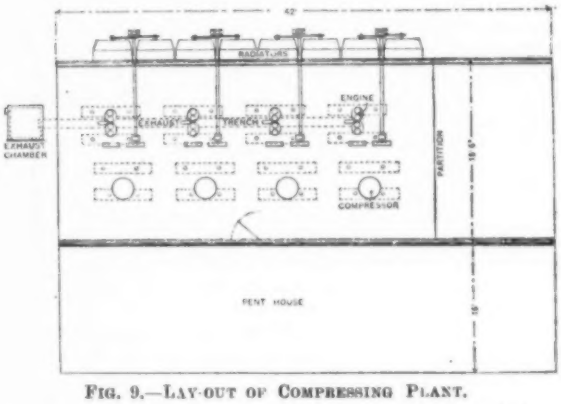


FIG. 9.—LAY-OUT OF COMPRESSING PLANT.

it will be seen that these vanes are inclined downward, with one edge resting against the corrugated surface. Assuming that this cell is now filled with the electrolyte, and the plates are connected to a source of current, the water in the electrolyte will be resolved into its constituent gases, hydrogen and oxygen. The whole system is submerged in the electrolyte. Oxygen bubbles will form on the positive plate and hydrogen on the negative. These bubbles on leaving their plates are deflected back by

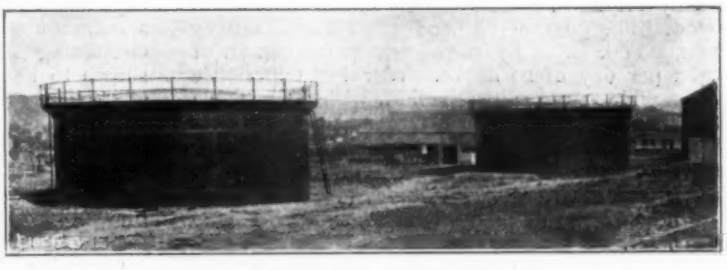


FIG. 10.—GAS-HOLDERS.

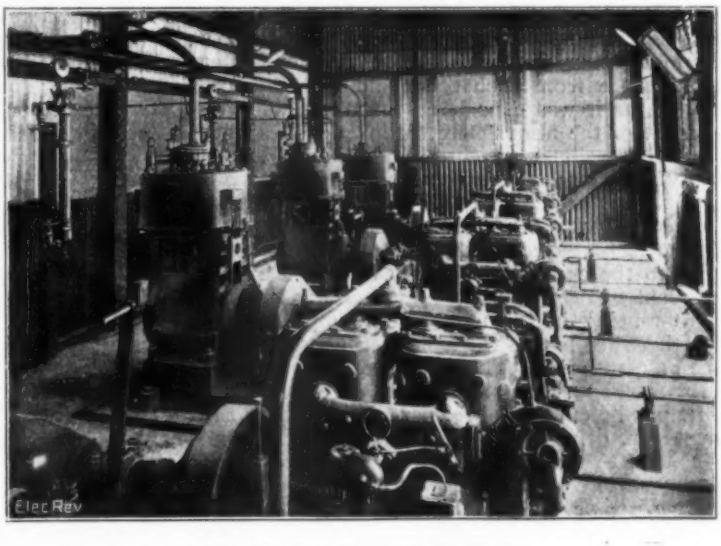


FIG. 11.—GAS COMPRESSING PLANT.

the glass vanes, and their natural tendency to rise is accommodated by the corrugations previously referred to. They pass along these and find themselves in the respective chambers formed by the rubber joint (*b*), whose lower edge is some inches below the level of the top vane. These chambers have each a port, opening into one of the two passages (*f*). It will be evident that numbers of these cells may be bolted together, with insulated bolts, to form a multiple system, the passages (*f*) thus becoming automatically manifold pipes. Each plate (*a*) has one face connected through its port (*j*) to one passage (*f*), and the other face connects in the same manner to the remaining passage (*f*). It follows that gases formed on these faces will find their way only into the passages with which they are connected. They then pass along them to separators, seen on top of the cells (fig. 7). There any entrained liquid is separated and returned to the cells. From them the gas flows to the purifiers. These purifiers consist essentially of a platinum wire coil, surrounded by a mass of platinised fibre, the whole being kept at bright-red heat by a suitable current. The gas, in its passage through this mass, is relieved by combustion of its impurities, mostly oxygen or hydrogen in each case. By this means its purity can be raised if necessary, above 99.7 per cent.

The make-up water is distilled, in a still supplied with warm water from the main engine jackets, and about 750 gallons per day is normally required. The caustic soda remains unaffected. The guaranteed production of the battery was 84,000 cu. ft. of hydrogen and 42,000 cu. ft. of oxygen per day of 20 hours. Working experience shows a wide range of production, with the variable factors of electrolyte temperature and current density. Normally efficiency grows with increment of current density, but there are several limiting factors.

Gas-handling Group.—Gas-holders.—The purified gases flow by 4 in. mains to two single-lift gas-holders, fig. 10, each of 20,000 cu. ft. capacity. As the sub-soil consisted of coarse gravel, and the total loading was not more than 1,500 lb. per sq. ft., the water tanks were erected without the usual concrete foundations. No trouble was experienced on this score. Provision was made for turning the warm circulating water from the main engines into these tanks in freezing weather. They were erected at some distance from each other and from adjacent buildings, as it was considered that the sudden displacement of the atmosphere, following on a bomb or shell explosion sufficiently close, might lead to the involuntary release and ignition of the very light and highly inflammable gas. This view was confirmed by subsequent experience elsewhere.

Compressors.—From the gas-holders, the gases are led to the compressor-houses, fig. 11. The arrangement of these is similar for each gas, the only variation being in the number of compressors, of which there are five in the hydrogen house and four in the oxygen house. These compressors were made by Brotherhood, and are capable of delivering 20 cu. ft. per hour at 2,500 lb. per sq. in. They have four stages, driven from a single-throw crank, and are similar to those employed for compressing air for torpedoes.

Each of these compressors is mounted on a bed-plate with a 35-B.H.P., 4-cylinder petrol engine, and is connected through a clutch and reduction gear. This is, of course, not an ideal drive, but as previously referred to, everything had to be sacrificed to speed of erection and the utilisation of existing and available plant. The compressing of these attenuated and inflammable gases presents some problems. Valves, pistons, piston-rods, and packings must all be of suitable materials and maintained in a state of the utmost efficiency. This means frequent overhauling. Matters are further complicated by the necessity of preventing oxygen from coming into contact with lubricating oils. A solution of pure castile soap is recommended for lubrication of those moving parts of the compressor which come into contact with this gas. To facilitate overhauls the layout shown in fig. 9 was adopted. This permits of a complete compressing unit being withdrawn from service into the repair shop, and a fresh one put into its place within 30 minutes, with the aid of a 2-ton overhead traveller. To facilitate this all gas and water connections to the unit have a rubber-hose insert fastened with clips. Petrol is piped from a common tank, placed outside, to each set. The circulating fans for the radiators were placed as shown to keep down temperature and dust in, and exhaust any gases outward from, the engine room. The method of silencing the engine exhausts was the same as that employed for the main engines, for the same reasons. The general arrangements ensured the absence of personnel and repair work from the engine room under working conditions, only the man in charge of the shift having reason to be there.

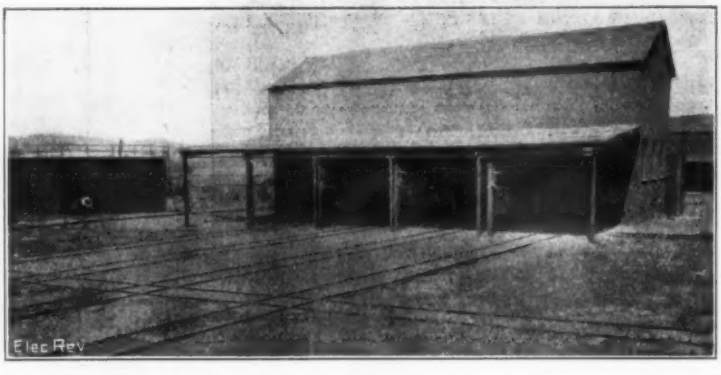


FIG. 12.—TUBE-CHARGING BENCHES AND TRACKWORK.

Charging Arrangements.—The compressed gases are conveyed in ⅜ in. bore, No. 8 gauge, hard-drawn copper piping to the tube-charging benches. These are seen in fig. 12, which also shows the system of turntables and trackwork adopted to permit of continuous charging and handling of gas-tubes, on special trucks capable of holding six tubes, each averaging 260 lb. in weight.

The author has been responsible for the design and erection of this plant, using only military labour.

Gattie Clearing-house Scheme. — The Departmental Committee, presided over by Sir Fortescue Flannery, that inquired into Mr. A. W. Gattie's proposal for a goods clearing house for London is unable to recommend its adoption. The report issued on December 23rd states that even at pre-war figures it might cost 300 million pounds if applied to the whole country. At present-day costs the outlay would be much greater, says the report, which is addressed to the Minister of Transport, and the committee is of the opinion that it cannot recommend such an expenditure of public money. This is only one of the many good reasons why the scheme is disapproved by the committee of inquiry, which, however, considers that the container system has undoubted advantages. The necessity for an improvement in railway terminal arrangements is recognised by the committee, which hopes that benefits will be derived from the institution of a Ministry of Transport.

ENGINEERING ON BOARD SHIP.

IN the course of his presidential address before the JUNIOR INSTITUTION OF ENGINEERS, on "The Influence of the War on Engineering," Sir E. H. Tennyson D'Eyncourt, K.C.B., M.I.N.A., said that there had never been any period during which the work of engineers had been of equal importance or been more indispensable to the community than during the great war, and it would be equally important during the period of reconstruction, and the later period of increased production which must follow, if the British Empire was to continue to prosper. They had learnt a great many things from the war, and were in a splendid position to take advantage of those lessons, if they took care to utilise the knowledge so gained in the proper way. In the next few years the engineers of this country would be called upon to play a part which might be a deciding factor in the future prosperity of the country.

In this connection there was a danger which they should be especially upon their guard against, and that was that with the tremendous shortage of all sorts of manufactured articles at home, whether great or small, this great home demand would keep their own industries well occupied for a considerable number of years; if they were not careful to foster their foreign trade they would lose the foreign market. It was, therefore, doubly incumbent upon them to increase production, so as to be able to meet as far as possible demands from abroad, and in this manner to retain the foreign markets, of which they would be in great need within a certain number of years.

All who were concerned with industry, of whom the engineers of this country were probably the most important body of all, must bend their minds to the task of producing a condition of stable equilibrium in labour. They should all endeavour to exchange views with the actual workers in the shops and try to arrive at a friendly understanding between those in authority and those who were working under them. The young men should take great pains to find out the point of view of the workmen and all concerned. Only in this way, by friendly interchange of views and knowledge of what both sides were thinking, would they arrive at an understanding and make it clear that the prosperity of all was intimately bound up together.

A few years before the war, Sir Charles Parsons had tackled the problem of combining the desired high speed of revolution of the turbine with the more efficient slow-running propeller by means of mechanical gearing, and the geared turbine design was adopted for destroyers, light cruisers, patrol vessels, and battle cruisers in quick succession, with most gratifying results. For some time past it had been the recognised type of machinery for all classes of warships, and it had proved itself to be suitable in all respects. Never, perhaps, had such an important step in machinery development made such rapid strides. In some of the destroyers they obtained a propulsive coefficient—that was, the ratio of efficient to indicated horse-power—as low as 40 per cent., whereas when they adopted the geared turbines they obtained a propulsive coefficient as high as 60 per cent. This meant that they could obtain either a greater speed with the same power, or obtain the speed which would formerly have taken a much greater power with proportionately less power. This, therefore, gave an immense military advantage to the design. This very marked improvement was to a somewhat less extent also apparent in the larger ships.

So far as they knew, no enemy ship was fitted with mechanically geared turbines, but some of them had been fitted with the Föttinger transformer. The loss of power in the Föttinger gear was 8 or 9 per cent., whereas the loss in the Parsons gear was only 1 or 2 per cent.

Another form of transmission which had come into prominence was the electric transmission which had been adopted by the United States Navy with considerable success, and on a smaller scale in our own Navy. It was being considered with much interest, as although it would appear to offer few advantages and some decided disadvantages for full power working (considering the success they had had with mechanical gearing), yet the advantages for low-pressure working might (if substantiated) prove of considerable value and well worthy of trial by ourselves, especially when it was borne in mind that warships steamed for perhaps 80 per cent. of their time at sea at a small fraction, say one-tenth, of their full power, so that nine-tenths of their power might be regarded as reserve to be used only in emergency. Economy at such powers became of very high importance.

In the largest class of submarines, the K boats, to obtain a surface speed of 24 knots they had to provide steam turbines, as it was impossible to get the 10,000 H.P. necessary with Diesel engines, which had been adopted for the surface drive in all previous submarines. The boats were a great success. It was interesting, in this connection, to point out that besides the steam turbines for full speed on the surface, the K submarines had the electric drive under water, and also a Diesel engine for use just before diving or just after coming to the surface. The transmission from the Diesel engine was through the electric motors, so that these vessels had not only geared turbines for the steam drive, but they also had electrical transmission with a Diesel engine and an electric battery drive when under water, and were therefore quite unique vessels in every way; they were 5 or 6 knots faster on the surface than any vessels the Germans produced.

Great economy had been effected by the use of oil fuel for the Navy during the war. It had been pointed out that it was a most uneconomical thing to burn oil fuel in a boiler for the purpose of steam raising, as very much greater economy could be achieved by burning oil fuel in internal-combustion engines. But, unfortunately, it had been found quite impossible with their present knowledge and experience to design internal-combustion engines burning heavy oils, which would meet the requirements of power, space, and weight demanded in naval ships. But the actual saving in labour by the use of oil for the Navy as against coal resulted in freeing approximately 150,000 men, who would otherwise have been engaged in dealing with the coal, from the time it was won at the face in the pit to the time it was shovelled into the furnace.

During the war more than 400 vessels burning oil fuel only in their boilers, and with an aggregate of some 12 million H.P., were completed for H.M. Navy.

It was up to the engineers of this country to make such improvements in internal-combustion engines as would enable propelling machinery of high power and of weight comparable to that of the present marine types of steam engines to be adopted. This would effect an enormous reduction in the amount of fuel required for the same horse-power. The actual annual production of crude oil in the whole world amounted to only some 75 to 80 million tons per annum, against 1,250 million tons of coal. If the 80 million tons of oil was taken as the equivalent of 100 million tons of coal, the amount of oil produced was still only one-twelfth that of coal. It was evident, therefore, that oil should be used as economically as possible.

Advance in auxiliary machinery was indicated by the recent efforts to adapt rotary driving to the requirements, a noteworthy example being the closed-feed system evolved by Messrs. G. & J. Weir, from which most promising results were expected, combined with a decided diminution in the corrosion of boiler tubes.

In the construction of internal-combustion engines, it was unfortunate that in nearly all cases they were manufactured in this country under foreign licences, necessitating their being always somewhat astern, but it was hoped that this reproach would not long continue, as there must be ability in this country to avoid such deplorable dependence upon the foreigner in such an important industry. It was a stigma that ought to be, could be, and must be removed.

The problem of employing Diesel engines for high-powered installations was a difficult one, requiring considerable thought and investigation. The successful low-speed installations in merchant ships only developed 400 to 700 H.P. per cylinder, and the number of cylinders necessary for a large aggregate power was so considerable as to make the arrangement in a ship almost, if not quite, impracticable. Further, the weight of such installations, being as much as 250 lb. per H.P. or more, was quite prohibitive in any type of warship.

To develop their intellectual resources it was necessary to devote great attention first to education and secondly to research. A point he wished specially to emphasise was that in the education of young engineers the study of psychology and human nature should not be overlooked. To obtain a good result it was absolutely necessary to understand one another and to work all together for the common good.

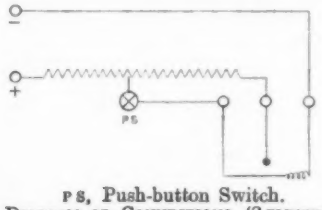
THE EDISWAN "POINTOLITE" LAMP.

THE "Pointolite" lamp, which was first evolved in the laboratories of the Edison Swan Electric Co., Ltd., in 1915, has undergone important developments during the past four years, and several new features were demonstrated at the meeting of the Illuminating Engineering Society on November 25th. The interest attaching to this wholly British invention, and the importance of the applications for which it is suitable, have led us to bring it before our readers in its latest forms, and we recently had the pleasure of investigating the subject at the company's works at Ponder's End, under the guidance of Mr. P. Freedman, who is conducting the researches and experiments in progress in this connection at the Ediswan Laboratory.

For the benefit of those who are not acquainted with the "Pointolite" lamp, we must explain that it is an arc lamp with one or two tungsten electrodes, the arc burning in a partial vacuum within a glass bulb similar to that of an incandescent-filament lamp. The lamp in the smaller sizes has three terminals, and is held in a special type of bayonet holder, which ensures its being inserted in the correct position. To strike the arc, the ionising power of a heated body is utilised; by means of a push-button switch the circuit through the ioniser is first closed, and when the ioniser attains the temperature at which it comes into operation, the push-switch is released, and the current leaps across the gap between the positive electrode—a spherical globule of tungsten—and the ioniser. Practically the whole of the light is emitted from the globule of tungsten, which becomes brilliantly incandescent; the light is nearly pure white in colour,

and as the globule is (in the 100-C.P. lamp) only about 2 mm. in diameter, it is practically a point source (hence the name) admirably suited for optical projection. Fig. 1 is a diagram of the connections, and fig. 2 a view of the 100-C.P. lamp, which has been on the market since 1915.

In order to adjust the length of the arc and to avoid undue wear on one part of the ioniser, the tungsten electrode is mounted on a thermal expansion device which moves the globule along the ioniser. Owing to the characteristics of the arc, a ballast resistance is necessary, as shown in fig. 1. The bulb is filled with inert gas at a pressure of about 5 in. of mercury. In the earlier lamps the ioniser took the form

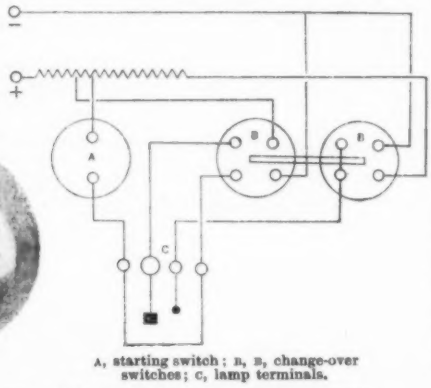


PS, Push-button Switch.

FIG. 1.—DIAGRAM OF CONNECTIONS (2-ELECTRODE LAMP).

of a thick filament composed of tungsten and refractory metallic oxides supported by two stout wires, and trouble arose owing to the tendency of this filament, when repeatedly switched on and off, to buckle and disturb the conditions. An important improvement was made by substituting a tungsten wire filament, wound into a small spiral at one end, with the ionising tube slipped over the straight portion, as in fig. 2. The ioniser is heated by the filament, the arc is struck on the spiral, and the tungsten electrode then moves away from the spiral to a position opposite the ioniser. The elasticity of this arrangement has completely removed the trouble, and greatly increased the life of the lamp, which is from 500 to 1,000 hours. This improvement, developed in 1916 and 1917, put the lamp on a satisfactory commercial basis. The next step was to develop a lamp of higher candle-power, and this was rendered possible by the new ioniser, together with the use of a larger tungsten globule. The latter was essential, as the parts must be in proper proportion; difficulties were met with, but were successfully overcome, and now globules of pure tungsten can be made of any size desired. In fact, the large globule is regarded as the secret of success in producing the high-candle-power lamp. Another departure was the use of two tungsten electrodes for the arc, and all the larger lamps are constructed on this principle; the arc is struck between the ioniser and a small globule, and then a new arc is struck between the latter and a larger globule, which is then the positive electrode—the smaller globule being first positive to the ioniser but finally the negative electrode. The three-electrode lamps having

FIG. 2.—POINTOLITE 100-C.P. LAMP.



A, starting switch; B, B, change-over switches; C, lamp terminals.

FIG. 3.—DIAGRAM OF CONNECTIONS (3-ELECTRODE LAMP).

four terminals, it was necessary to substitute an Edison screw holder for the bayonet type, to make room for the four concentric contacts. The arc between the two electrodes is made possible by the double ionising action which takes place—that due to the emission of electrons from the hot negative electrode, and that due to the atomic collisions in the gas.

The first 500-C.P. lamps had positive electrodes of thin tungsten plate, which were quickly perforated; the development of a method of making large thick plates overcame this difficulty. The plate is square in shape, but the negative electrode is a large spherical globule.

The 500-C.P. lamp was introduced in 1916 and 1917. Further experimental work was carried on in 1918, leading to the production of a lamp of 1,000 C.P. in 1919, working on the same lines as the 500-C.P. lamp.

The life of the lamp is limited by the following factors: the derangement of the ioniser; the gradual curvature of the plate electrode; the flattening of the globule; and the blackening of the bulb. The first of these has been mastered, though in the case of the 100-C.P. lamp the deposit of tungsten on the ioniser and the corresponding wastage of the globule have to be reckoned with. The second and third cannot be altogether obviated, but the fourth has been remedied by an ingenious invention of Mr. Freedman's—a glass cup of a particular shape and size, which is welded to the inside of the bulb over the arc, the lamp being fixed bulb uppermost. The connection current of hot gases from the arc rises into the centre of the cup and descends down the sides of it, forming a deposit on the wall of the cup but leaving the glass of the bulb perfectly clean in the case of the large lamps, and nearly as clean in the 100-C.P. lamp. This device doubles the useful life of the lamp, which in the case of the 500-C.P. lamp averages over 500 hours. It also checks the volatilisation of the electrodes by keeping them surrounded by an atmosphere saturated with tungsten vapour.

Not only has 1,000 C.P. been successfully attained; a lamp of no less than 4,000 C.P. is now being developed, with a view to its substitution for the carbon arc in bioscope projectors, a most important application. A fixed-focus lamp has been produced during the past year, in which the positive electrode is hemispherical in shape, with the convex side opposed to the ioniser; the electrode in this case remains stationary. The flat side presents a perfectly uniform disk

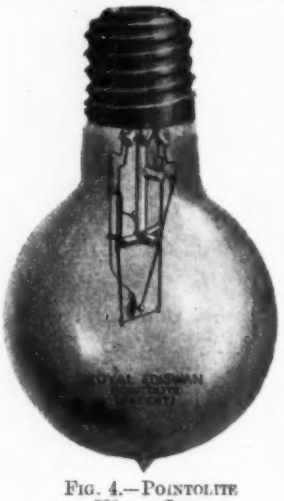


FIG. 4.—POINTOLITE 500-C.P. LAMP.

FIG. 5.—FIXED-FOCUS LAMP.

of light, and is 1 cm. in diameter. This lamp has been found extremely useful at the National Physical Laboratory as a pyrometric standard, the pyrometer being focused on the disk. The temperature of the latter can be varied, by adjusting the current, from a dull red to brilliant incandescence, and thus, once the lamp has been calibrated, the readings on an ammeter give a perfect measure of the temperature.

The minimum practicable voltage across the arc itself is 45 volts, and the "Pointolite" can be worked off any D.C. circuit above 50 volts; but lower voltages have been rendered possible by a recent improvement, bringing the minimum arc voltage down to 15 volts, so that a portable 100-C.P. set can be made, working with a 30-volt storage battery.

The lamp alone (without the external resistance) consumes 0.65 watt per candle in the case of the 100-C.P. lamp; 0.5 W./C.P. at 500 C.P.; and 0.42 W./C.P. at 1,000 C.P. The last-named lamp takes 7 amperes for starting up, 3 amperes for the first arc, and 8 amperes when fully in operation.

The candle-power of the "Pointolite" depends on the nature and pressure of the gas in the bulb, the length of the arc, and the size of the electrodes; it follows a law of the form (for 100 C.P.) $C.P. = K\ (I - C)^n$; where I is the current in amperes, C is a constant (about 0.2 amp.), $n = 1.8$, and K is a constant.

It should be observed that the candle-power mentioned, being approximately the same in all directions, is practically the mean spherical C.P. The intrinsic brilliancy of the electrode is about 16,000 C.P. per sq. in. in the 500-C.P. lamp, and 12,000 in the 100-C.P. lamp, but the latter can be run up to 60,000 C.P. per sq. in., when the globule is practically molten.

The bulb of the 1,000-C.P. lamp is 6 in. in diameter. An important feature of the "Pointolite" is that it can be used in a deep parabolic reflector, utilising an enormous proportion of its flux of light, to produce a parallel beam. Used for projection in the ordinary way, the light utilised is only that which falls on the condenser of the projector, but by placing the arc at the focus of an ellipsoidal reflector, and masking the direct rays, a converging beam can be obtained without using a condenser. During the war the 100-C.P. fixed-focus lamp was largely used with a parabolic reflector for signalling purposes. We have already mentioned the application of the "Pointolite" to the bioscope and other projectors; it is also suitable for microscopy, surgery, galvanometers and oscillographs, the shadow-projection of gauges, photography, colour-matching, and theatrical purposes.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Appointments in India and Burma.

I have read with interest the various letters on the above subject, and the letter signed "G. Y. M." represents my views.

To it, however, might be added, that, as it will take 20 years or more of careful living to make one's independence one should not go out to the East much older than 30 years in the first instance.

Some of your readers may have heard of "The Call of the East"; I can assure them it is a real one. I am at present in England, and shall be glad to find myself shortly in the East again; as Kipling says: "Ship me somewheres east of Suez."

The life of the East is a much more luxurious one than that of the West. A large house, a number of servants, and a table equal to that of the best London hotels, are what one usually gets after a few years out there.

The social life is also very attractive, and on a higher plane than many electrical engineers can aspire to in England.

The general opinion prevalent in England of the ill-effects of the heat is a very exaggerated one, and with plenty of changes of clothing, electric fans in office and home, and the easier time one usually obtains at business, there is no valid reason why with occasional visits to a hill station, one should not keep as fit, if not fitter, than one keeps in England.

It is, however, quite a good thing to come to England for, say, six months in every three years. It not only tones one up somewhat, but it forces one to appreciate the many advantages of living in the East, which one would perhaps otherwise not do to the extent that the circumstances merit.

Gymkhana.

England,
December 22nd, 1919.

The Fuel of the Future.

I do not profess to be an expert on the above subject; by that I mean that I cannot trot out data with such fluency as Mr. Klemens displays. I am not a "gas man," but have been engaged for a number of years in experimenting with a view to retrieving some of that 80 per cent. waste heat you mention in your article on fuel economy.

Instead of attempting to prove that you obtain more B.TH.U.'s by obtaining only 20 per cent. effective energy from each pound of coal than the gasworks is capable of, why does not Mr. Klemens approach the question from a broad-minded point of view?

In his article on "The Fuel of the Future" he entirely leaves out, excepting coke and tar, the valuable by-products obtained from coal. We have to consider the question from an economic basis; thus, is it more efficient to the community to burn coal as we now do in producing electricity, or to pass it first through a sieve, as it were, as is done in a gasworks, extract its by-products, and with the remaining gas generate your electricity? Let us have a discussion on these lines, for I am convinced where one gas exponent is, figuratively, trying to tear out the eyes of an equally perfervid electrical expert, progress will always be very slow, *and figures merely evasions*. Only by an exchange of ideas can we eat into that deplorable figure—80 per cent.

Economy.

A Scandalous Waste of Coal.

Travelling from Canterbury by the S.E. & C. Railway on Wednesday night, the 10th inst., I saw a primitive method of burning coal, which would have been a discredit to the ancient Britons had they used coal. To keep the stand-pipes (for supplying the locomotives with water) from freezing, one, and sometimes two, braziers were in use. Each measured about 15 in. wide, 15 in. deep, by 2 ft. long, and each had a large coal fire in it weighing perhaps 1 cwt. The heat from these was chiefly warming the air of Kent, but at times the wind carried a small fraction of it towards the stand-pipes, and some reached them by radiation. If the stand-pipes were encased with sheet iron, leaving a 2-in. space all round, closed at the bottom, with a suitable outlet at the top, and the flue from a small slow combustion stove were connected to the lower end of this casing, probably one-fifth the quantity of coal would more effectively prevent the freezing. The amount of coal burnt by these large braziers throughout Great Britain during a windy, frosty 24 hours can be imagined.

Alfred S. E. Ackermann,
B.Sc. (Eng.), M.Cons.E., A.M.I.C.E.

London, S.W.
December 19th, 1919.

[*Electric* railways do not require stand-pipes.—EDS. ELEC. REV.]

Merchant Ships as Generating Stations.

The determining factors in ship design are tonnage (or carrying capacity) and speed, only sufficient power being provided to propel the ship at a pre-determined speed at the least cost per ton-mile. Ships with large carrying capacity and great bulk have often only moderately powerful engine units. Thus a ship of 5,000 tons would have engines indicating about 1,500 I.H.P., and would probably cost anything between £100,000 and £120,000, according to age and general condition, and would be capable of an output of 1,000 KW. (approximate). Thus the capital sunk for such an output would be out of all reason, especially as the greater part of the vessel would have no earning capacity. Again, marine engines would be unsuited for the generation of electricity, being very heavily built and of slow speed, the latter necessitating the use of a multipolar alternator of large dimensions half the diameter of which would most likely be too great for the space between the line of shafting and ship's bottom. Marine boilers are designed for hand firing and the fitting of mechanical stoking gear would prove rather a costly matter. Engines are also unsuited for use with superheated steam and are ungoverned. One can hardly understand a person considering such a scheme seriously. Such a vessel moored in a dock or harbour would be liable for dock or harbour fees. Coaling would be costly, and all ashes would have to be transported outside the dock area for disposal. There would also be liability to damage from other shipping and the consequent interruption of supply. Of course, a smaller and higher powered vessel could be obtained, such as an old turbine-driven destroyer or torpedo boat, where the I.H.P. per cu. ft. of capacity of hull would be greater. However, even in this class of craft the machinery would be unsuited for the generation of electricity, as the turbines (unless of geared type) would be less efficient than those of the higher speed type as used in generating stations ashore. By far the better plan, where it was essential to have the generating unit afloat, would be to have the engines erected in a barge after the style of the floating station recently offered for sale by H.M. Government, which consisted of two turbine-driven alternators and D.C. generators, together with boilers and necessary auxiliaries, in fact, a complete floating generating unit. High-speed turbines could then be used, keeping the space per kilowatt generated down to a minimum and the efficiency could be made to compare favourably with any generating station ashore of the same capacity.

L. P. Morinan.

Cardiff.
December 29th, 1919.

Combined Lighting and Ignition Set.

I have to thank you for inserting my letter of the 5th inst., and for the ample apology to The Rotax Motor Accessories Co., Ltd., contained in your footnote.

With regard to the letter from Messrs. C. A. Vandervell and Co., Ltd., in your issue of the 19th inst., the ignition dynamo made by The Rotax Motor Accessories Co., Ltd., is essentially different from that described in the 1910 patent mentioned. I have taken the advice given and searched the patent files, but beyond noting that our "rival" is prolific in compiling a certain type of combination patent, I have found nothing helpful. I am glad to see that the type described has been abandoned in favour of the type made by Messrs. Rotax.

With regard to the kind offer of information, I am always glad to acquire knowledge, and any information given me will be gratefully received—and acknowledged.

For the **Rotax Motor Accessories Co., Ltd.,**
H. F. PARISH.

London, N.W.
December 22nd, 1919.

THE LAY-OUT OF SWITCHGEAR.—Mr. W. J. Webber asks us to point out that his name has been incorrectly quoted by our correspondents as "A. J. Webber."

Representation of British Firms in Norway.—We learn that there is a strong feeling in Norway in favour of dealing with agents resident in Norway in preference to agents resident in one of the neighbouring countries. The Norwegian Chamber of Commerce, London, Inc. (Kingsway Chambers, W.C. 2), has been asked to bring the matter to the attention of British manufacturers and exporters. It has sent us a copy of a circular issued in English by the various Agents' Associations in Norway, on "The Securing of Sole Agencies in Norway to Norwegians," the views expressed in which are endorsed by important trade associations. Obviously the interests of manufacturers and exporters should be better served by an agent in the importing country than by one whose headquarters are in an adjacent country. It is reasonable to assume that the former is naturally better acquainted with the requirements and tastes of his country, and with the purchasers themselves. Furthermore, he is more likely to have an established organisation properly covering his district, and will regularly work his ground.

BUSINESS NOTES.

The "Electrical Review" Index.—As it is still necessary to effect every possible economy in paper consumption, the index to Vol. 85 of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d., post free. Any reader or advertiser at home or abroad who requires a copy for binding, or for other purposes, is asked to make early application therefor, to the publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C. 4.

Mining Safety Lamps.—The *London Gazette* for November 23rd publishes an order made by the Secretary of State, Home Department, approving of a number of types of safety lamps, including the "Ceag" electric safety lamp bull's-eye type (for officials, or in case of emergency only).

Census of Production, 1921.—The Board of Trade has issued an order determining that a Census of Production shall be taken in the year 1921, limited to certain trades, including the following :—

Coal and ironstone mines under the Coal Mines Regulation Acts.
Coke works at collieries.
Iron mines under the Metalliferous Mines Regulations Act, and iron quarries.
Iron and steel trades (smelting, rolling, and founding).
Engineering trades (including electrical engineering).
Shipbuilding and marine engineering trades.
Cycle and motor trades.
Railway carriage and wagon trades.
Copper, brass, lead, tin, zinc, and other metal trades (except the gold and silver refining trade.)
Chemicals, coal tar products, and drugs trades.
Building and contracting trades.
Brick and fireclay trades.
China and earthenware trades.
Gas undertakings.
Electricity undertakings.

New Belgian Electrical Company.—La Société des Cableries et Trefileries Liegeoises is the name of a new company which has lately been formed at Renory-Angleur, near Liege, with a capital of 1,200,000 fr. (nominally £48,000), to manufacture cables and wire.

New French Electrical Company.—A new company has lately been formed in Lyons, with a capital of £40,000 and the title La Société Nationale d'Entreprises Electriques.

Bradford Corporation Contract for Car Motors Cancelled.—The Bradford Corporation placed an order with Messrs. Brown, Boveri & Co., Ltd., in 1915, for the supply of 200 car motors, which the contractors subsequently were unable to fulfil on account of conditions arising out of the war. It has now been mutually agreed, as the result of friendly discussion between the parties, that as the contractors cannot guarantee delivery of the motors by next summer, the work shall not be proceeded with. The Tramways Committee has accordingly passed a resolution recommending that the contract in question shall be cancelled by the mutual consent of the parties.

A Birmingham Celebration.—At the Queen's Hotel, Birmingham, on December 19th, Messrs. J. H. Tucker & Co., Ltd., manufacturers of tumbler switches, accessories, and switchgear, entertained their chiefs of departments and outside representatives to dinner. It was the first function of the kind given by the firm since the war, and was really a celebration of the completion of a wonderful record of war work and of the resumption of peace activities on a scale which already eclipses its pre-war activities. The function provided a pleasing manifestation of the good relations prevailing between Messrs. Tucker and their staff. Members of the staff present included the following :—Messrs. H. E. Bateman (production manager), W. J. Line (chief of technical department). J. J. Evans (cashier), G. T. Baker and E. J. Brothers (London representatives), G. E. Gibson (South-Coast representative). S. G. Smith (Scottish representative), and G. L. Thorburn (New Zealand representative). Mr. W. Y. Smith (superintendent of Assembly) was absent owing to illness. The following were among the guests :—Lord Torphichen, late Director of Fuse Production, Ministry of Munitions; Mr. F. R. Wade, late Inspection Department, Woolwich Arsenal; Mr. N. B. Rosher, Inspector Munitions Areas, Ministry of Munitions; Mr. R. D. Summerfield, Inspector Munitions Areas, Ministry of Munitions; Mr. H. Evans, Ministry of Munitions; Mr. J. R. Baxter (Baxter and Impey), past president, Electrical Contractors' Association; Mr. H. E. Walker (Walker Bros.) chairman (Midland Section), Electrical Contractors' Association; Mr. E. A. Reynolds (Reynolds and Bradwell), honorary secretary, Electrical Contractors' Association. Mr. J. B. Tucker, joint managing director, presided, and he was supported by Mr. T. R. Martin, his energetic colleague in the managing directorship; Mr. C. F. J. Tranter, director; and Mr. J. Tucker, the father of the founder, and the Grand Old Man of the firm. During the evening, Mr. Tucker proposed, and Mr. Tranter seconded, the toast of "The Visitors," which was responded to by Lord Torphichen and Mr. Walker. Mr. Wade and Mr. Rosher proposed and seconded respectively, "The Electrical Industry," and Mr. Baxter replied. "The Firm" was given by Mr. Bateman, seconded by Mr. Baker, and supported by Mr. Smith. Mr. Martin responded. Finally, the health of the chairman, Mr. Martin, and Mr. Tranter, were proposed by Mr. Wade and Mr. Evans, and responded to by all three. In the course of the speeches it was mentioned that during the war Messrs. Tucker manufactured for the Government two million articles of various special kinds for war purposes. This was in addition to the production, as far as circumstances permitted, of their normal products. When the question of the supply of high-explosive fuses became acute, Messrs. Tucker were amongst the earliest invited to make them, and those in authority testified to the excellence of their workmanship and finish. In the references that were made to the future of the industry, stress was laid upon the development that could be looked forward to when the production of power was centralised; the speakers emphasised the severity of foreign competition. Germany, it was pointed out, would rehabilitate herself. She could at this moment produce electrical goods at a price at which we could not even buy the raw material. American and Japanese competition added to the difficulties of the position. One or two speakers advocated Protection as the only possible solution of the problem, with preferential treatment for the Colonies. Despite these warnings, however, there was a ring of confidence in the speeches, suggesting that the resource, initiative, and energy of the firm would enable it to surmount all difficulties.

On the previous evening, Messrs. Tucker gave a Christmas social and welcome home to demobilised employés. Some 70 of the staff were in the Army, and seven made the supreme sacrifice. The social was held in the works canteen, which was divided into two sections—one for a whist drive and the other for a dance. In addition, a musical entertainment was given. The artists were all employés of the company. Mr. J. B. Tucker occupied the chair, and Mrs. Tucker distributed the whist and dancing prizes, as well as those won in the recent air-gun competition. A vote of thanks was passed by the 500 members of the staff and works present to Mr. and Mrs. J. B. Tucker for their presence.

Plant for Disposal.—Leeds Corporation Tramways and Highways Committee invites offers for about 150 tons of worn-out tramway rails, a quantity of scrap manganese tramway points and crossings, one hand crane on truck, and three second-hand smith's bellows. For full particulars see our advertisement pages to-day.

The Moulders' Strike.—It was stated on Tuesday that new efforts were being made to bring about a settlement of the above dispute, which has now lasted for three months, and is most seriously hampering various branches of the engineering and allied trades, 100,000 employés in which have been thrown out of work, in addition to the moulders themselves. The assistance of the Prime Minister was being invoked, and the Minister of Labour was returning hurriedly from Scotland.

Railway Rates Advance.—The Ministry of Transport has publicly announced the alterations of rates for goods traffic on the railways, which take effect as from January 15th, 1920. The advances vary from 25 per cent. in the case of coal, coke, and patent fuel, to 100 per cent. for small parcels conveyed by merchandise train. The provision of trucks for traders advances by 50 per cent., with a minimum charge of 9d. per ton. A new schedule of charges is issued for the detention of wagons and sheets.

Engineering Profit-Sharing Scheme.—*The Times* states that a profit-sharing scheme has been set in operation by MESSRS. GEORGE RICHARDS & CO., LTD., machine tool makers, Broadheath, Altrincham, by which the whole of the 1,000 employés are practically admitted into co-partnership and given an equal share in the profits of the concern. The scheme, after making provision out of the profits for a deduction of 7½ per cent. on the present day valuation of the firm's business, allocates the profits on the year between the shareholders and the workpeople, and it is anticipated that the addition to the earnings of the latter will not be less than 50 per cent. Employés may invest the bonus in shares, upon which the directors guarantee a payment of 7½ per cent.

Rising Prices of Electrical Plant.—An illustration of the difficulty of giving a correct estimate owing to the rapid rise in the price of materials, &c., is afforded in the case of Falkirk. Recently Mr. W. W. Lackie, of the Glasgow Corporation Electricity Department, reported regarding the proposal of Falkirk burgh to obtain further borrowing powers to the extent of £30,000 for new plant. To the last meeting of the Town Council, Mr. Lackie wrote intimating that in his statement showing the estimated additional capital expenditure, he said that a 1,500-KW. alternator set complete, would cost £5 per KW., or £7,500. He had just seen an approximate quotation for a 1,500-KW. set, and the price was given as £14,000. If it was not too late, he suggested that the Council add £7,000 to the £29,872 mentioned in his statement.

Meters for Holland.—*The Times* contained the following advertisement on Tuesday last :—"Quotations wanted for electrical meters for export to Holland in large quantities; complete descriptions, illustrations, prices, and delivery dates requested by the Technical Commercial Office, Joh. Visser, Beeklaan, 470, The Hague, Holland.

The Price of Coal in France.—The Paris correspondent of the *Times* stated on December 29th, that the coal situation was very bad. "One cannot expect to purchase a cargo of coal at much less than 430 fr. a ton (over £12 a ton at 35), which is, of course, a ruinous price for industry to have to pay."

Christmas Entertainments, &c.—The St. Helens Cable and Rubber Co., Ltd., Warrington, and some of their employés, last week entertained to dinner the near relatives of employés of the firm who were killed in the war. The children were provided with an illuminated Christmas tree with presents of toys.

Both the Tramways Committee and their employés at Oldham were agreed that no cars should be run on Christmas Day, and instead the men held a social gathering at which they welcomed home their colleagues who had been on war service. The men had themselves raised £100, and the Committee gave an additional £75. A memorial tablet at the Mumps Depôt to fallen tramwaymen was unveiled in the morning by Councillor Cheetham, chairman of the Committee, who was accompanied by the Mayor and Mayoress, and afterwards some 450 of the men attended a memorial service at St. Mary's Church. The social gathering took place in the afternoon, and the children present received gifts.

On Christmas Eve at the Sterling Works, Dagenham, Mr. Guy Burney, managing director of the Sterling Telephone & Electric Co., Ltd., on behalf of himself and the company, presented the members of the Sterling Ladies' Football Team with medals in commemoration of their achievement in going through 1917-1918, 1918-1919 undefeated, during which period they assisted to raise some £800 for charitable objects. The men's team wound up the half-season by qualifying for the final of the Barking Hospital Cup, defeating N U R. by 12 goals to nil. They have reached the divisional semi-final of the London Junior Cup.

MESSRS. CHAMBERLAIN & HOOKHAM, LTD., Solar Works, Birmingham, held a staff ball on the evening of Friday, December 19th, at the Imperial Hotel, Birmingham. Some 130 members of the staff and their friends were present, many of the former having only recently returned from the fighting services. The music for a varied programme of dances was rendered by Miss Coxen's orchestra. The evening was in every way a pronounced success. Mr. W. S. Sprague, the managing director of the company, acted in the capacity of M.C.

Calendars, &c.—MESSRS. MAWDSLEY'S, LTD., of Zone Works, Dursley, Glos., have sent us a wall calendar with monthly slips for 1920. "Gladys" is obviously a favourite, for all that we said about her last week is confirmed by her adoption for a year by this firm also.

Greeting cards have been received from the STERLING TELEPHONE AND ELECTRIC CO., LTD., and the AUTOMATIC TELEPHONE MANUFACTURING CO., LTD.

From the KEIGHLEY GAS AND OIL ENGINE CO., LTD., of Keighley, we have received a wall calendar for 1920, which consists of a block of boldly printed date slips upon a stout card base in the form of one of their Imperial engines.

THE WHITE ELECTRICAL INSTRUMENT CO., LTD., of 2 to 6, Gloucester Street, Clerkenwell, E.C. 1, have sent us a vest pocket court-plaster case, with calendar for 1920 printed thereon.

A small calendar, with monthly slips, has been received from MESSRS. H. WOGAN & Co., of 71, Stockport Road, Ardwick, Manchester.

MESSRS. E. P. ALLAM & Co., of 107-109, Gray's Inn Road, W.C. 1, have issued a desk-standing calendar, with monthly slips in red and gilt framework which will brighten all around for 1920; calendar for the entire year pasted on the back.

MR. W. H. SUGDEN, of Wakering Road, Barking, Essex, has also prepared a desk calendar, with monthly date-cards.

From MESSRS. ALEXANDER HAWKINS & SONS, of 125-128, London Road, Southwark, S.C. 1, there has come to hand a wall calendar, with monthly slips below a poultry picture entitled "Queuerioosity."

MESSRS. J. H. WOOLLISCROFT & Co., of New Quay, Liverpool, have prepared a calendar, with daily slips, with figuring in red, mounted on a stout card base.

MESSRS. PIRELLI, 144, Queen Victoria Street, London, E.C., have again issued one of their very serviceable wall calendars for the new year. A block of date and engagement slips, printed boldly in red, is mounted on a strong metal base. The design appearing above the block shows an aeroplane holding a Pirelli tire over a bird's-eye view of the company's works.

Trade Announcements.—MESSRS. FITT BROS. & DAVIES, LTD., of Swansea and Cardiff, have added to their mechanical engineering works an electrical engineering department, which will be devoted to general works and colliery electrical repairs and supplies. The management of the branch will be in the hands of Mr. B. T. Davies as works manager. The head office will be at 17, Wind Street, Swansea.

MR. F. C. EDWARDS has commenced business as an electrical engineer at High Street, Tenterden (Kent).

THE CANADIAN NATIONAL CARBON CO., LTD., and the NATIONAL CARBON CO., INC., have had their commandeered premises returned to them by the Government, and they are now back at Imperial House, 15-19, Kingsway, London, W.C. 2.

MR. H. B. ARNOLD has resigned his position with the "Z" Lamp Manufacturing Co., Ltd., and is commencing business on his own account for the supply of electrical accessories, &c. He desires to receive lists of A.C. and D.C. motors, switchgear, fittings, &c., at 135, Kingsway, Ponders End, Middlesex.

MR. B. E. CROW (late London representative of the Sterling Telephone and Electric Co., Ltd.), and MR. R. C. TOOGOOD (late assistant manager of the Electrical Supplies Co.), have resigned their positions with these companies and commenced business on their own account as wholesale electrical suppliers, at 15, Wardour Mews, D'Arblay Street, Wardour Street, London, W. 1.

THE BRITISH AND ALLIED ELECTRICAL AGENCY, LTD., has removed to larger offices and showrooms at Ely House, 18, Charterhouse Street, London, E.C. 1.

Bankruptcy Proceedings.—E. BOHM, electric lamp manufacturer, 5, Boxworth Grove, Barnsbury, London.—Application for debtor's discharge, to be heard at Carey Street, W.C., on January 21st.

A Municipal Electrical Loan.—We observe that the Aylesbury Municipal Council is inviting, through advertisement in the financial Press, tenders for loans amounting to £80,000, in sums not less than £5,000, for a period of 19 years, for the electricity undertaking.

Book Notices.—It is announced in the December number of the *Industrial League and Council Journal*, which completes its first volume, that commencing with January, 1920, the publication will appear monthly. The present number contains a report of the annual meeting of the Council and of other meetings held in October, including that at which Mr. Benn delivered an address on "Should Wages be Lowered?"; also of one held at the Guildhall in November, when Sir Auckland Geddes spoke on the "Industrial Outlook." There are some interesting notes on the "Apprentice Problem," setting forth the views collected before the war from educational, industrial, Trade Union and commercial organisations, and other authorities.

"*Journal* of the Institution of Electrical Engineers," Vol. LVIII, No. 286. December, 1919. London: E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the inaugural address by the President (Mr. R. T. Smith), and the Chairman's addresses at the following Centres:—North-Eastern (Mr. W. Cross), Irish (Mr. R. Tanham), Western (Mr. A. Ellis), North Midland (Mr. W. M. Selvey), Scottish (Mr. W. B. Hird), North-Western (Mr. J. A. Robertson), South Midland (Dr. C. C. Garrard), and a paper on "The Calculation of Tooth Reluctance: A Suggested Improvement on Hird's Method," by Mr. S. Neville.

"The M. & C. Apprentices' Magazine." Vol. 3, No. 12. Pp. 259 + xvii.—This is the Christmas number of the very able quarterly magazine published at the works of Messrs. Mavor & Coulson, Ltd., of Glasgow. The production includes a number of well-written articles of both technical and literary value, and is copiously illustrated by photographs and pen and ink sketches.

"Technical Book Review Index." Vol. 3, No. 1. Pp. 68. 50 cents per annum. Published by the Technology Department of the Carnegie Library, Pittsburgh, U.S.A.—A comprehensive index of reviews that have appeared in various trade and technical journals, giving a brief description of the nature and scope of each work. It is concerned mainly with pure and applied science, but a few works on allied subjects are included. Books are indexed under authors' names arranged alphabetically.

"The Life and Letters of Silvanus Phillips Thompson, D.Sc., F.R.S.," has been prepared by his wife and his daughter, Helen G. Thompson, B.Sc., and will be published by T. Fisher Unwin, in the spring, at 21s.

"Neglected Revenue: A Suggestion to the Prime Minister." By Sir Guilford Molesworth. London: Vacher & Sons, Ltd. Price 1d.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVIII, No. 12. December, 1919. New York: The Institute. Price $1.

"*Transactions* of the Institution of Civil Engineers of Ireland." Vol. XLIV. Dublin: The Institution.

"Precis d'Electricité Theorique." By L. Bloch. Paris: Gauthier Villars et Cie.

"Jahrbuch der Elektrotechnik." By Dr. K. Strecker. Berlin-München: R. Oldenbourg. Price 24 marks.

Electricity Undertaking for Disposal.—The Receiver for the Weaverham Electricity Supply Co., Ltd., invites offers for the undertaking, with the whole of the effects, including the provisional order for the districts of Weaverham and Acton and Sandiway and Cuddington. See our advertisement pages to-day.

Catalogues and Lists.—MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., Woodland Works, Chadwell Heath, Essex.—Price leaflet of the "Popular" dry battery; also a list of reduced prices of "Kwik-Lok" lamp shade carrier. The reduction is possible owing to increased manufacturing facilities reducing the cost of production. Copies of the list over-printed will be supplied to traders.

NATIONAL X-RAY REFLECTOR CO., Chicago, U.S.A.—Pamphlet illustrating and describing the "Tru Daylight," a lamp specially designed for use in shop interiors.

THE BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, E.C. 4, have sent us two attractively coloured wall showcards, advertising the "Mazda" lamps. One is a painting of an oak tree, symbolising strength and emphasising British manufacture. The other is headed "The Electric Lamp for the Home," and depicts a shaded lamp throwing its rays upon a table. Both are brass-stiffened at top and bottom, and provided with eyelets for hanging. Copies can be obtained from Mazda House.

ATHOL ENGINEERING CO., 9, Peru Street, near Broughton, Manchester.—Leaflet describing the "Athol" outline template.

THE GENERAL ELECTRIC CO., 67, Queen Victoria Street, E.C. 4.—Up-to-date catalogue of electric heating and cooking appliances, priced and illustrated. Also Specifications Nos. 15A and 71A, detailing "Salford" automatic circuit-breakers and G.E.C. motor starters respectively.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD.—A novel show card, advertising the "Sterling" sanitary glass telephone mouthpiece. This is a very effective cardboard model of a desk set with an actual sample of the mouthpiece fitted to it.

Patent Restoration.—An order has been made restoring Letters Patent No. 9,151, of 1914, granted to Mavor & Coulson, Ltd., and S. M. Mavor, for "Improvements in, or connected with, machines for use in mining minerals, particularly adapted for use in mining coal and the like."

Patent Extension.—A petition presented by Mr. C. Smith for the extension of Patents Nos. 16,242, of 1906, and 22,525, of 1907, for inventions of improvements in fire and temperature alarms or indicators, is to be heard on February 3rd.

New Belgian Electrical Company.—Les Cableries Belges, Société pour la Fabrication des Cables et Fils Electriques et l'Industrie du Caoutchouc is the name of a new company which has lately been formed in Brussels (33, Rue de Luxembourg).

The Export Credits Scheme.—The Board of Trade announces that Rumania has been added to the list of countries to which this scheme applies.

LIGHTING AND POWER NOTES.

Australia.—SYDNEY.—To cheapen the supply of electricity the Local Government Department contemplates making large increases in plant and the area of distribution, and it has been stated that the price per unit would decrease from the present rate of 5½d. to about 3d.

VICTORIA.—A total of £3,000,000 is to be spent in developing the Morwell brown-coal field to provide electricity at cheaper rates for the city of Melbourne and other districts.

Barnes. — PROPOSED EXTENSIONS. — The electrical engineer has submitted two alternative schemes for extending the plant. Proposal (*a*), involving an expenditure of £20,000, provides for additions to existing plant, but (*b*) will mean changing over from the reciprocating plant at present in use to a turbine-driven unit of 3,000-KW. capacity and from D.C. to A.C. The cost of the latter scheme is given as £77,000.

Brazil.—INDUSTRIAL DEVELOPMENT.—Many extensions in the industries of Brazil were projected by the Minister of Agriculture, Commerce and Industry, in a recent speech. The steel and iron trades can be made to produce twice the present revenue if advantage is taken of the opportunities presented by the ease with which the South American markets can be supplied. The chief difficulty in iron and steel production is the supply of fuel, but it is considered that the application of electricity will eliminate this to a great extent. Water power is obtainable from the Serra do Mar between Victoria and Itabira and between Rio and Sao Paulo, for supplying many smelting works, and also the principal ports of the country. The Federal Government would bear the expense of erection of the necessary hydro-electric plant, and by selling power cheaply to consumers, would encourage the establishment of all classes of factories.

Dundee.—WATER POWER.—The latest development in the Tummel hydro-electric scheme is marked by a joint report to the Corporation of the city by C. S. Meik & Buchanan and Sir Alex. Binnie, Son & Deacon, together with a report dealing mainly with the conclusions arrived at by these firms, prepared by Mr. H. Richardson, the city electrical engineer and manager. The joint report is most exhaustive. It is divided into three main heads :—(1) A general description of the complete scheme ; (2) an indication of how the complete scheme can be best developed to meet the growing demand for electricity, with the estimate of cost ; and (3) the effect of the scheme when developed on the flow of the River Tay, and other general considerations. Commenting on the joint report, Mr. Richardson states that comparisons between steam plant and water power might lead to the conclusion that there was not sufficient probable saving to decide in favour of using the water power, but there were many other factors to be considered. If the first instalment were completed, the possibility of extension up to the likely requirements of Dundee would be assured for many years to come, whereas it appears doubtful whether the Harbour Trustees will grant facilities for the next extensions of the present Carolina Port generating station. Refusal to grant sufficient facilities will mean that a new station will have to be built some distance from the city, as no other sites are available at present. Even if the present estimated cost, as given by Messrs. Meik and Binnie, of the first instalment of the water scheme, proves approximately sufficient to cover the actual cost, then it seems clear that the ultimate advantages to be gained warrant proceeding with the water-power extension. One million and a quarter in cash is involved in the first instalment of this water-power scheme, and as the present capital account is £340,180, the huge extension contemplated will bring up the capital account to £1,577,180. By an alternative extension scheme (steam plant) the capital cost would be £1,026,880, a figure less than the Tummel Valley scheme, but it is pointed out that while under it the cost per unit at Dundee would be ·83d., the cost under the Tummel Valley scheme would be ·472d. or ·583d. if the existing capital expenditure is included.

HOUSING SCHEME.—It has been decided that the dwellings in the new Corporation housing scheme at Logie shall be lit electrically, and that the charge shall be a fixed one of £2 per annum, with ¼d., plus 15 per cent. per unit consumed.

Falkirk.—LOAN.—The Town Council is to apply to the Secretary for Scotland for powers to borrow £30,000, which it is proposed to expend in extending the electrical plant and mains. It was pointed out that it was necessary that the additional plant should be installed at an early date.

Grantham.—PRICE INCREASE.—The Urban Electric Supply Co. has increased the charges for energy as under :—Power, first 100 units per quarter, 7d. per unit ; next 3,000, 3½d. ; beyond, 2½d. Heating, first 100 units per quarter, 3½d. ; beyond, 2½d.

Godalming.—PRICE INCREASE.—The Urban Electric Supply Co. has adopted the following scale of charges :—Heating, first 100 units per quarter, 4d. ; beyond, 3d. ; power, first 100 units per quarter, 7d. ; next, 3,000, 4d. ; beyond, 3d.

Glossop.—PRICE INCREASE. — The Urban Electric Supply Co. announces that from the December meter readings, the charges for electricity will be :—Power, first 100 units per quarter, 7d. ; next 3,000, 4d. ; beyond, 2½d. Heating, first 100 units per quarter, 4d. ; beyond, 2½d.

Great Harwood.—PROV. ORDER.—The Council has applied to the Board of Trade for an extension of the Electric Lighting Provisional Order, and has also appointed a sub-committee to make arrangements for an electric lighting scheme, with power to act.

Gourock.—BULK SUPPLY.—Negotiations are proceeding between the Town Councils of Greenock and Gourock for the supply of electricity for the latter. The supply is now being offered at a cheaper rate, owing to the fact that the original main extends to the torpedo factory, and, when laid down, it was capable of providing a greater supply for these works than was necessary.

Halifax.—BREAKDOWN.—The electric light failed for 20 minutes on December 17th, consequent on a defect in the main switch of one of the principal machines at the generating works.

High Wycombe.—PRICE INCREASE.—The Electric Light and Power Co. has increased charges for electricity as under :—Power, first 100 units per quarter, 7d. ; next 3,000, 4d. ; beyond, 3d. ; and heating, first 100 units, 4d. ; beyond, 3d.

Huddersfield.—AREA EXTENSION.—Application is to be made to the Board of Trade for an order authorising extensions of electric lighting to the districts of Kirkheaton, Kirkburton, Lepton, and Meltham.

Hull.—INADEQUATE SUPPLY.—The situation caused by the restrictions recently imposed upon power consumers has become so acute that the Lord Mayor invited representatives of employers and employés of the iron trades to a conference. This was refused, an independent inquiry being insisted upon. The fuel overseer had given shortage of coal as the reason for deficiencies in supply, but the electrical engineer stated that the trouble was due to lack of boiler power. In view of these conflicting statements, the Electricity Committee has decided to appoint an outside expert to report on the matter.

Ipswich.—YEAR'S WORKING.—The report on the electricity department for the year ended March 31st, 1919, shows a total expenditure of £62,748, including £12,441 capital charges, and a total income of £55,140, representing a loss of £7,608. Total units sold decreased by 1,059,413, or 15·6 per cent. to 5,737,961 ; lighting decreased by 18·2 per cent. to 687,220 ; power by 14·46 per cent. to 4,486,810 ; traction by 23 per cent. to 545,578 ; and public lighting increased by 15,323 to 18,353 units. A sum of £1,338 was received from the rates towards providing working capital. The number of consumers increased by 35 to 1,996 ; kilowatts connected increased by 28 to 8,360 ; maximum load recorded was 2,205 KW. for lighting and power, and 424 KW. for traction. The year under review was, so far as operating the plant was concerned, the most difficult in the history of the undertaking. The conditions under which the station had to be run were reflected by the cost of repairs which increased by £1,662, or 46·8 per cent.

ELECTRIC VEHICLES.—The working expenses of the electric vehicle garage were £555 ; the expenses increased by £289, or 109 per cent. The revenue increased by £537, or 173 per cent., which does not include electricity sold for charging vehicles, the quantity being 58,065 units, which brought in an amount of £380.

NEW PLANT.—The Electric Supply and Tramways Committee have reported that, unless extra plant is installed, there will be an insufficient reserve to provide against breakdown. In view of the heavy demands which will have to be met during the winter 1920-21, additions costing the estimated amount of £30,000 are urged. The proposals include an expenditure of £25,800 for a 3,000-KW. turbo-alternator with necessary condensing plant and inter-connecting pipes.

London.—FULHAM.—The Borough Council has been recommended by the Electricity and Lighting Committee to revive the shop-lighting agreements suspended during the war. The proposed annual charge per lamp is £3 12s., including cleaning and renewals. Energy will be supplied through the ordinary consumers' meters.

STEPNEY.—Acting upon the advice of the borough electrical engineer and manager, the Electric Supply Committee has submitted to the Borough Council a proposal to erect a new sub-station in the north-east part of the borough. It is proposed to install two 1,000-KW. converters. The approximate cost is given as £99,850.

HACKNEY.—The new street lighting system, recently installed, consists of over 400-B.T.H. "Efracta" lanterns, each containing a 300-watt, ½-watt type lamp. The majority of the rays from these lamps are re-directed at an angle slightly below horizontal, and efficiently illuminate the areas between the standards, which generally make a sharp contrast with the illuminated area in the lamp's immediate vicinity. The Hackney system will ultimately total 500 of these lamps. The "Efracta" was described in our "New Devices" columns on December 27th, 1918.

ST. PANCRAS.—The London County Council Finance Committee has recommended the Council to sanction the borrowing of £89,209 by the Borough Council for extensions. This amount includes £17,000 for completion of buildings, and £33,000 for a 5,000-KW. turbine.

The Council Labour majority promises electric light, with free wiring, in working-class homes.

Manchester.—NEW PLANT.—The new steam turbo-alternator at the Stuart Street generating station commenced its work on December 15th. It is the most powerful set so far installed by any municipality in Great Britain. The turbine is of 35,000 H.P., and the alternator develops 25,000 KW., or two and a-half times the amount of electricity needed to propel the 700 tramcars in Manchester. The city's three generating stations have now a capacity of about 120,000 KW., Stuart Street alone having 92,000-KW. capacity. The largest boiler in Great Britain, a Babcock & Wilcox water-tube boiler, which evaporates over 100,000 lb. of water per hour, has been installed recently at the Stuart Street works. The new plant was inspected by the members of the Corporation, and later Alderman W. T. Dagnall, chairman of the Committee, referred to the work of the department during the past five years. They had never let down the munition manufacturers in the area, and the Armistice meant a reduction of 25 per cent. of the demand for electricity. During the past 10 years the plant had been increased by 120 per cent., and the maximum demand had increased in the same ratio. The average cost of production per unit gradually fell until 1914, but since then, owing to the war, it had risen, and was still rising, and to-day the cost was the same as in 1909. On December 9th last, the output for the first time exceeded a million units. There were now 2,000 people waiting connection to the system, and the Committee could not get the meters and the labour to connect them as quickly as it wished.

Masham.—BILL.—A meeting is to be held on January 7th to consider the promotion by the Urban District Council of a Bill in the ensuing session of Parliament, to acquire, among other things, the undertaking of the Masham and District Electric Supply Co., and to supply electricity in the district.

Melrose.—PROPOSED PRICE INCREASE.—The Electric Supply Corporation has applied to the Board of Trade for an order to increase the charges for electricity.

Newport (Mon.).—STRIKE.—A serious situation was created at the docks on December 18th, when work was brought to a standstill by a lightning strike of the men employed at the power stations. The men claim the whole of the conditions applying to shopmen, although the company's view is that they are not shopmen; the matter has been under the consideration of the Railway Executive Committee for some time. With the exception that the electric light was kept on, the whole of the power available for working the docks was suspended.

New Zealand.—HYDRO-ELECTRIC DEVELOPMENTS.—The Horahora Electric Power Works, erected by the Waihi Gold Mining Co., at a cost of £200,000, a few years ago, have been purchased by the Government. Water power to the extent of 9,000 H.P. is used there, and the Government intends to supply the southern part of the Auckland province as well as the Waihi Co. It is expected that two additional units will be installed to take part of the Auckland city load. Further developments are projected in North Island hydro-electric schemes, including the Arapuni plant, which will consist of several generators capable of developing 13,000 H.P. each.

Paisley.—VISIT OF COMMITTEE.—The burgh electrical engineer recently received the Second Municipal Ward Committee, and conducted the party round the Corporation power station, and the leading particulars of the plant were explained. Total plant capacity, 7,100 KW.; two-phase A.C. is generated at a pressure of 2,000 volts and transformed down to 200 at the various sub-stations. A new 2,500-KW. turbo-alternator was installed last April, and an addition of two new boilers was made during November.

Peterborough.—RECONSTRUCTION.—The Town Council has discussed the report of Mr. W. M. Selvey on the electricity undertaking, and has decided to proceed with the first stage of reorganisation which will involve an outlay estimated at £40,000. It is expected that it will eventually be necessary to carry out the rest of the scheme at a cost of £100,000.

Ramsgate.—PRICE INCREASE.—The Electric Supply Co. has, from the December meter readings, increased the price of electricity as under:—Power, first 100 units per quarter, 7d.; next 3,000, 4d.; beyond, 3d. Heating, first 100 units per quarter, 4d.; beyond, 3d.

Richmond-on-Thames.—PRICE INCREASE.—The Board of Trade has granted an order to the Electric Light and Power Co. authorising an advance in the price of electricity to 6d. per unit for lighting, 2d. for heating, and 3½d. for power.

Rochdale.—SUPPLY OF POWER TO FACTORIES.—Since the Corporation undertook to supply electricity in bulk for power purposes, quite a number of firms in the district have availed themselves of the opportunity to convert their methods of driving to electricity. There have been quite a large number of partial conversions during the past 10 years, but the first of the large cotton mills in the district to make a complete change over in every department and drive the mill throughout by electricity is that of Messrs. Holt & Ogden, Ltd. Electricity will be supplied at 3,000 volts, to be transformed on the premises and distributed through motors varying in size from 20 H.P. to 125 H.P., each being under separate control. Messrs. William Tatham, Ltd., who are making further extensions to their works at Belfield, have decided to adopt a mixed system of alternating and continuous-current electric power. The supply, in the first place, will be taken from the Corporation main, transformed from high to low pressure, and again converted from alternating to direct current for meeting the calls of the variable-speed machines. The design of Mr. W. D. Watson, electrical engineer, has been approved in both these cases, and the tenders have been let to the Rochdale Electric Co., Ltd. The Ensor No. 3 Mill, now under construction, is also to be run by electric power supplied by the Corporation.

Southend.—ELECTRIC HEATING.—With regard to an application for a supply of electricity required for heating radiators, and in view of the great demand for energy for lighting purposes, it has been decided that the Committee is unable to supply consumers at the present time for the purpose indicated.

Stoke-on-Trent.—MAINS EXTENSIONS.—Application is being made to the Ministry of Health for sanction to borrow £29,936 for mains extensions, &c.

Ventnor.—STREET LIGHTING.—The Urban District Council has accepted the tender of the Isle of Wight Electric Light Co. for lighting public lamps used prior to the war, until March 31st, 1921, and in the meantime tenders for the whole of the public lighting are to be obtained from the Electric Light Co. and the Gas Co.

Wallasey.—EXTENSIONS.—Acting upon the recommendation of Sir John Snell, the Council proposes to temporarily reduce its extension scheme and its cost from £111,300 to £66,240. The electrical engineer has put forward an amended scheme for the installation of a 5,000-KW. set, which will be sufficient for the next two years.

Wareham.—ELECTRIC LIGHT SCHEME.—Owing to the present inadequacy of the town lighting, the Mayor has been asked to call a public meeting to consider the formation of an Electric Lighting Company.

Warrington.—YEAR'S WORKING.—The report for the year ending March 31st, 1919, shows a gross revenue of £63,388; working expenses, £48,395; out of the balance £4,908 was paid as interest on loans, and £6,075 to sinking fund, thus leaving a net profit of £3,720. The units generated numbered 9,682,154, an increase of 11·5 per cent. The units sold to private consumers numbered 7,093,205; public lighting, 61,417; traction, 502,532; private lighting increased by 33,262 to 494,924 units; and power by 774,063 to 6,598,281 units; 895 consumers are now connected to the mains.

West Ham.—LOAN.—Application has been made for sanction to borrow £164,500 for extension purposes; in the course of an inquiry by Col. T. C. Ekin, it was stated that owing to the insufficiency of the borough supply, it had been necessary to borrow from East Ham, Leyton, and the London County Council.

Wolfhill (Queen's Co.).—ELECTRICITY IN MINING.—Good progress is being made in the construction of modern machinery for installation in the Moderhagh Colliery, which includes electric pumping, haulage and coal-cutting plant underground. The colliery is expected to be producing coal early this year.

Wolverhampton.—PURCHASE OF PLANT.—In May, 1917, negotiations were commenced between the Ministry of Munitions and the Electricity Committee for the supply of electricity to H.M. phosphorus factory. The agreement entered into provided that the Ministry should contribute £50,000 towards the cost of the plant, the total cost of which was £78,000, the Corporation to find £28,000 under sanction from the Local Government Board. In addition the Ministry agreed to pay £3,270 towards existing boiler-house alterations. When the armistice was signed the supply ceased. As a result of negotiations, the Corporation offered to purchase the plant at its cost price, less depreciation amounting to £10,000. The Ministry agreed to "write off" the sum of £3,270 paid towards the alterations, and the building now becomes the property of the Corporation. The Committee now recommends application for a loan of £40,000 to effect the purchase, the Director of Electric Power Supply having promised to advise the Ministry of Health to grant a long period of repayment.

PRICE INCREASE.—The Committee also proposes that a further increase of 15 per cent. be made in the charges for electricity on all accounts (including meter rent), making a total increase of 100 per cent., and that this increase be applied to the gross total of all accounts after the meter readings taken at the end of the December, 1919, quarter, and that for the purpose of removing doubts the increases hitherto made in the charges for the supply of electricity, amounting in the aggregate to 85 per cent., shall apply to meter rents.

TRAMWAY AND RAILWAY NOTES.

Argentina.—RAILWAY ELECTRIFICATION.—The Western Railway is about to proceed with the electrification of its system as far as Castelar, 20 miles out of Buenos Ayres. The estimated cost is £1,000,000, but it is considered that the results will entirely justify the expenditure. The Southern Railway is expected to announce its intention to electrify its lines to La Plata shortly.

Australia.—VICTORIA.—The Railway Co.'s report for the year 1918-9 states that much has yet to be done to complete the plant of the Newport power station, and the Jolimont, Newmarket, and Middle Brighton sub-stations. The total cost of the electrification work in hand at present is £2,997,415, exclusive of the cost of new carriages and structural alterations to existing stock, and it is not expected that the programme will be completed before the end of 1921.

MELBOURNE.—The Railway Commissioners have reported that up to June 30th this year, a total of £2,867,000 had been expended upon the electrification of suburban lines.

Barrow-in-Furness.—TRAMWAY SALE.—In connection with the purchase of the tramway system by the Town Council, as already announced, the track is reported to be in fairly good condition, but the cars are unsatisfactory. After allowing for expenditure to be incurred in bringing the system up to greater efficiency, the sum of £96,250 was agreed upon as the purchase price. The company will continue to carry on the undertaking until it is handed over to the Council on January 1st. Mr. J. R. Groves, the company's engineer will retain his post under the Town Council at a salary of £600 per annum.

Belfast.—SUPPLY FAILURE.—On two or three occasions recently the tramway services were interrupted by want of power in the evenings when the "peak" point was reached, coinciding with low tide in the Lagan, when the condensers were not able to work properly. This, it is stated, may recur till the new power station at the harbour is in going order. In November, 1918, the output was 1,852,414 units; last October it was 2,730,621, or an increase of nearly 50 per cent. At the present time one-third of the electricity is going to the shipyards, one-third to the tramways, and one-third to the general consumers.

Blackpool.—EXTENSIONS.—The Fleetwood tramroad is to be connected up with the local system at the Glynn and Talbot road. Owing to cost, estimated at £90 per week, the Tramways Committee has decided not to run cars from Marton to South Shore.

Bolton.—NEW CABLES.—The Tramways Committee has approved a report submitted by the borough electrical engineer concerning the existing feeder cables and distributors, which he considers are overloaded, recommending the provision of cables of larger capacity, in order to safeguard the tramway supply. The work is to be carried out as soon as practicable.

Bradford.—NEW MOTORS.—The order placed by the Corporation in 1915 with Messrs. Brown, Boveri & Co. for 200 tramcar motors, which, by reason of the conditions arising out of the war, it has been unable to fulfil, is by mutual agreement not to be proceeded with, and the Corporation is at liberty to secure motors from another source. The contractors were unable to promise delivery until next summer.

Cardiff.—NEW CARS.—The Electric Light and Tramways Committee is to invite tenders for 15 complete tramway cars and for 15 chassis. In the tramway manager's opinion, unless the moulders' strike ends, the service will have to be withdrawn; scrapped brake blocks are now being re-used.

Continental.—SPAIN.—Owing to the refusal of the Madrid tramway companies to make any concessions to the strikers, negotiations between the employers and the men have been broken off. Some cars are being run under police protection.

SWEDEN.—A proposed scheme for the electrification of the Stockholm-Gothenburg line will probably be placed before the Riksdag next year. It is calculated that the work will take three years to complete, and will involve a total expenditure of 60,000,000 kronen. Efforts are also being made to speed up the electrification of the Gellivara-Svartön Railway, which has already received Government approval.

Halifax.—TRAMWAY LOSSES.—The borough treasurer has informed the Electricity Committee that during the eight months ended November 30th the loss in working was £12,085, although a higher revenue than was estimated had been received. It was considered that the increased fares yielded very little extra revenue, as the people took shorter journeys. A further increase to 2d. a mile is contemplated, the Corporation being of opinion that unless such measures are taken the resultant loss for the year will be £20,000.

On Christmas Eve a small landslide close to St. Thomas's tramway stopping stage covered the line with several tons of stone and gravel and stopped all vehicular traffic. After four hours there was sufficient clearance for a single-line car service. Investigation as to the cause of the slide and as to responsibility is being made

Hastings.—CHANGE OF SYSTEMS.—The Tramway Co. is considering the substitution of the overhead system for the Tilling-Stevens petrol-electric system at present in use on the front-line Esplanade. Experts who reported on the existing system expressed the opinion that the only way to obtain an efficient system was to change over immediately to overhead working. Apart from inherent defects in the present system, the reason of its being unsatisfactory was the lack of power, and this could not be overcome, as it was impossible to increase the size of the equipment of the cars. The Tramway Co. is again making efforts to obtain the necessary powers from Parliament for the suggested improvement, a previous application having been unsuccessful.

Ipswich.—YEAR'S WORKING.—The report for the year ended March 31st, 1919, on the tramway department, shows that the revenue increased by £3,958 to £38,775; working expenses by £3,208 to £30,279; leaving a net profit of £2,295, against £1,478 last year. The passengers carried increased by 154,831 to 6,224,608; units used decreased by 163,075 to 546,578.

Jamaica.—STRIKE.—The Kingston tramway employés struck work on December 26th, and the whole service was suspended. The men demand 2d. per hour increase in wages.

Lancaster.—EXPERT ADVICE.—The Town Council has decided to call in Mr. A. R. Fearnley, tramway manager, Sheffield, to submit a report on the question of mechanical transport in the borough, and as to what, in the financial interests of the undertaking, would be the best system of traction to adopt. There are both tramways and electric 'buses, neither of which really pays because of restricted services. Mr. Chorlton's services as traffic manager are to terminate, and Mr. J. Patterson will take over the tramways superintendency at the end of January, at a salary of £300.

London.—LONDON COUNTY COUNCIL.—Before the Advisory Committee on London Traffic, dealing with the financial position of passenger-carrying undertakings in the metropolitan area, Sir Harry Howard, controller of the L.C.C., said that the deficiency on the working of the tramways was at present £137,000, and it was anticipated that next year it would be £580,000. Relief could only be obtained by means of legislation in regard to the rating of tracks, road maintenance, &c. He did not consider that the debt charges constituted an unusual burden, and it would be possible, instead of repayment by equal instalments, to set up an annuity on the cumulative sinking fund principle. That would save over £100,000 a year. The capital commitments at the present moment were in the neighbourhood of two millions of money, and he believed that the revenue could not meet that figure. If there were less competition with motor-omnibuses they could probably meet the expenses on the present fares. Sir Albert Stanley, on behalf of the Traffic Combine, said that, excluding the subsidy of £560,000 which the District Railway, a controlled line, received from the Government, and approximately a reasonable sum as allowed for renewals, the operating results from all the 10 companies for the current year would show a loss of £600,000. That was without making provision for fixed charges and interest. The estimated loss in 1920 would be £2,600,000. The total expenditure for 1920 over that of 1919 would be £2,650,000, and that sum would have to be raised in increased earnings. There was not the remotest chance, Sir Albert continued, of meeting the loss except by an increase of fares. The services carried 1,300,000,000 passengers in the year, and an addition of a halfpenny each passenger for each journey would realise £2,500,000 yearly.

Sir Albert Stanley, speaking at a dinner at the Savoy Hotel recently, said that the underground railways combined undertakings were now carrying about four million passengers per day, or 1,300 millions per year. They had 35,000 employés, 2,578 omnibuses, 894 tramcars, and 1,360 railway carriages. Their commitments in the way of improvements represented six millions of money, which sum had to be raised.

PASSENGER TRAFFIC.—Sir Albert Stanley stated last week that for the last 10 years records of the passengers carried in London showed the following aggregate totals:—Omnibuses, 5,818,374,141; trains, 2,881,264,160; tramcars, 1,760,720,397; a total of 10,460,358,698. During 1918 alone, 652,562,327 passengers were carried by the omnibuses; 379,438,072 by the tubes and underground railways; and 198,334,499 by the tramcars; a total of 1,230,334,898, or an average of 3,370,780 passenger per day, including Sundays. The 1919 figures are estimated to be still larger.

UNDERGROUND INTERRUPTION.—Owing to cable trouble, traffic ceased for some time on the evening of December 23rd, on the Underground Railway between East Ham and Campbell Road Junction. Passengers were taken meanwhile *viâ* Mark Lane and Fenchurch Street.

Lytham.—TRAMWAY PURCHASE.—It is proposed to promote a Bill in Parliament to acquire the section of the Lytham and St. Anne's Tramway Co.'s line within the Council's area. St. Anne's Council has also taken similar steps, and has fixed the purchase price.

Manchuria.—PROPOSED TRAMWAY.—Applications have been made by an ex-minister for permission to construct an electric tramway between Dairen and Port Arthur, and another one at the latter town. The first proposal will effect a reduction of 14 miles, compared with the railway route, but is not expected to receive official sanction. The other will probably meet with approval.

New Zealand.—AUCKLAND.—The total receipts of the tramway undertaking for the year ending June 30th, 1919, were £292,503, and the number of passengers carried, 73,785,594. Last year's figures were £294,564, and 44,823,967 respectively.

Preston.—Year's Working.—The total income for the year ending March 31st, 1919, was £77,930, the total expenditure being £52,877, resulting in the transfer of £25,054 to the net revenue account. The revenue increased by £14,433. A considerable portion of the single track requires immediate renewal for which service the present renewals fund is inadequate. Working expenses increased by £9,433, or 22·2 per cent. The increased rates came into operation in August, and resulted in an increase in revenue of 20 per cent., with a decrease in passengers of 15 per cent. During the year the passengers carried numbered 15,126,474, against 15,455,163; working expenses per car-mile were 10·66d., against 9·14d.; units generated numbered 1,767,154, against 1,833,816, at a cost of 0·855d., against 0·798d.

Rawtenstall.—Through Running.—An intimation has reached Accrington tramways authority, from Rawtenstall Corporation, to the effect that employés on Rawtenstall tramways have decided that the through running of cars between Accrington and Rawtenstall shall cease after December 31st. This decision was taken by Rawtenstall tramway workers without waiting for the approval or endorsement of the Tramways Committee.

South Lancashire.—Fare Increase.—The Board of Trade has sanctioned an order empowering the South Lancashire Tramways Co. to increase 1d., 1½d., 2d. and 2½d. fares by ½d., and 3d., 4d., 5d. and 6d. fares by 1d., as from January 1st. This does not apply to workmen's fares.

South Shields.—Light Railway.—The Light Railway Commissioners who inquired into the application of the Corporation for sanction to construct a light railway from the borough boundary to Cleadon Village, to serve its housing scheme, have announced their decision as follows:—That the application be granted so far as it relates to the construction of one mile of light railway from its commencement at a junction with the authorised tramway in the borough. The Commissioners, in arriving at this conclusion, have attached weight to the importance of reducing capital expenditure, and of economising in the consumption of material, at the present time. In their opinion the evidence at the inquiry indicated that a light railway co-terminus with the boundary of the housing site at Cleadon Park would adequately meet the immediate needs of the case, and that the construction of nearly a mile of line (involving an expenditure of, say, £30,000), which is cut out from the scheme by this decision, will be avoided without material detriment to the objects and the interests of the Corporation. This decision has been come to without relation to the proposed new thoroughfare on the line of the light railway, and the alternative scheme of the Durham County Council for widening the main road to Sunderland.

Walthamstow. — Second-Hand Cars.—The Town Council is buying eight second-hand tramway cars from Rotherham Corporation.

Wolverhampton.—Fares.—The Town Council is to reconsider the question of the increase of fares throughout the system, with a view to reinstating penny fares for short stages.

Bill.—The Corporation is promoting a Bill in Parliament to extend the boundaries of the borough, and also the tramway system.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Exchanges. — Mr. Pike Pease, Assistant Postmaster-General, replying to a question in the House of Commons, said that a number of automatic telephone exchanges had been installed, and others would be installed in places where efficiency and economy were likely to be secured. He regretted to find in the recent tenders that the prices asked by manufacturers for automatic apparatus were extremely high.

Brazil.—According to *Commerce Reports*, the Brazilian Government has granted concessions to the Central and South American Telegraph and Cable Co., for the laying of submarine cables (1) linking the cities of Santos and Rio de Janeiro to any part of the territory of Uruguay; and (2) from Rio de Janeiro to Cuba *viâ* the Island of Fernando de Noronha.

Cable Delays.—Serious cable delays are still reported between the Far East and this country. The claim that by the end of September last the normal period of transmission had been reduced to 2 or 2½ days in the case of India, 2 to 3 days for the Straits Settlements, 1½ to 2 days for China, and between 5½ and 7 hours in the case of Australia, does not appear to have been substantiated.

Canada.—The Canadian Landline Companies have adopted the same arrangements as the United States Companies as to the formation of a Registration Bureau, and will charge for local telegraphic registrations $2.50 per annum. Reversible addresses will not be registered.

Sweden.—A Swedish engineer has invented a method of ensuring secrecy in connection with wireless telegraphy. Patents have been taken out in several countries, and a company, A.-B. Cryptograph, has been formed to exploit the invention.—*Economic Review.*

United States.—War-time operation of the telephone and telegraph systems of the country cost the Federal Government $14,418,237, according to a report of Postmaster-General Burleson, transmitted to Congress on November 13th by President Wilson. This sum represents the difference between the net earnings of the companies taken over and the compensation guaranteed by the Government. Total net earnings of the telephone and telegraph lines during federal control were reported to be $70,387,532, while the compensation assured was $83,055,769. The total deficit included an estimated $3,000,000 for settlement of future claims. Small independent companies operated by the Government reported a surplus of $57,428. Reported deficits of the American Telephone and Telegraph Co., operating 36 subsidiary companies, were $9,290,170.31, while the Western Union Telegraph Co. asked an adjustment of $921,511. The Ohio State Telephone Co., of Columbus, Ohio, operating four subsidiary companies, showed a deficit of $392,123. The Government claim against the Postal Telegraph-Cable Co. was listed at $2,124,392. "If the unadjusted claims of the Government against the Mackay companies be taken into consideration," said Mr. Burleson, "the estimated obligations of the Government will be substantially reduced."

• The U.S. Navy Department has removed the ban on wireless transmitting stations as far as non-commercial installations are concerned. All amateurs, however, must secure licences from the Radio Service Bureau of Navigation. Apparatus manufacturers are expecting an increased volume of business as a consequence of this decision.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Sydney.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

Perth, W.A. — February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Barking. — Urban District Council. Second-hand air compressor (electric or steam). (See this issue.)

Battersea. — January 21st. Borough Council. One 5,000-kw. turbo-alternator, with condensing plant; one 1,500-kw. rotary converter; pipework for the 5,000-kw. turbo-alternator; switchgear for the 5,000-kw. turbo-alternator and 1,500-kw. rotary converter.

Belgium.—January 17th. Belgian Post and Telegraph Authorities, La Salle Madeleine, Brussels. Telegraph and telephone cables.

Bootle.—January 7th. Corporation. Wiring 34 houses under the housing scheme. (December 26th.)

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Cavan.—January 12th. Electric Light & Power Co. Suction gas engine and plant; alternative tender for duplicates, electric generator and motor booster; alternative tender for duplicate, generator, electric storage battery, D.C. switchboard. (December 26th.)

Dundee. — January 23rd. Corporation. Electricity Department. Three 750-kw. converter sets; one 300-kw ditto; 11,000 v., E.H.T. switchboard; two 750-kw., D.C. control panels; one 300-kw. ditto. (December 19th.)

Halifax.—January 5th. Electricity Department. Supply of stores (including lighting fittings and electrical accessories, cables, meters, &c.), from February 1st, 1920, to March 31st, 1921. (December 19th.)

Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (See this issue.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

FULHAM. — January 13th. Electricity Committee. Manufacture, delivery and laying, complete, duct, E.H.T. cable, &c., between the generating stations of Fulham and Hammersmith. (December 19th.)

STEPNEY. — January 22nd. Electricity Supply Committee. Two water-tube boilers, chimneys, economisers, &c., and one 5,000-KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

CAMBERWELL.—February 2nd. Borough Council. 12 months' maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

Manchester.—January 14th. Electricity Committee. One 2-ton electric lorry (specification No. 23); one 10/15-cwt. electric van (specification No. 24). (December 26th.)

Rhondda.—January 5th. Urban District Council. Electricity Committee. Steel or wood poles and the completion of overhead lines. (December 19th.)

Sheffield. — January 2nd. Electric Supply Department. Supply and laying of six-core, E.H.T., split-conductor cable (contract No. 268). (December 12th.)

Tynemouth. — January 12th. Electricity Department. Ten 250-K.V.A. transformers. (December 19th.)

Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas.

It is to be of sufficient capacity to communicate with similar stations in the United States and Europe. It must have one installation for emission of continuous waves served by high-frequency alternators, and another for the emission of damped waves to communicate with wireless stations not provided with the system of continuous waves. Alternating tri-phase electric current now distributed at 190 volts and 50 cycles is available, but the plant must have a reserve motor.

Tenders to Ministerio de Fomento de los Estados, Unidos de Venezuela.

CLOSED.

Bedford.—Electricity Committee :—

Electrician's work for six months.—R. H. Crawley.

Belgium.—Tenders were recently invited by the municipal authorities of St. Gilles, Brussels, for the supply and installation of a new 1,000-H.P. engine and continuous-current generator. The lowest tender for the engine was that of the Société des Ateliers Bollinckx, of Brussels, and for the dynamo that of the Société des Ateliers de Constructions Electriques de Charleroi.

Bolton.—Electricity Committee :—

E.H.T. switchgear for Back-o'-th'-Bank generating station.—Metroplitan Vickers Electrical Co., Ltd.
12,000-KW., 3,000-R.P.M. turbine.—Escher Wyss Co., Zurich, Switzerland.
12,000-KW. alternator for above.—Mesropolitan-Vickers Electrical Co., Ltd.

Government Contracts.—The following Government contracts were placed during November, 1919 :—

DIRECTOR OF NAVY CONTRACTS DEPARTMENT.

Searchlight motor generators.—Newton Bros. (Derby), Ltd.
Switchgear.—Switchgear & Cowans, Ltd.
Torch batteries.—Sunlight Manufacturing Co., Ltd.
Impulse gear for torpedo tubes.—Armstrong, Whitworth & Co., Ltd.

MINISTRY OF MUNITIONS.

Rewinding alternator.—Metropolitan-Vickers Electrical Co., Ltd.
Batteries.—Chloride Electrical Storage Co., Ltd.
Battery boxes.—Bond Bros.
Electrical equipment of aircraft.—Austin Motor Co., Ltd.
Generating sets and motors.—English Electric Co., Ltd.
Spares for magnetos.—W. H. Johnson.
Turbo alternator.—Brush Electrical Engineering Co., Ltd.

INDIA OFFICE, STORES DEPARTMENT.

Baudôt apparatus.—Elliott Bros.
Balancers.—Lancashire Dynamo Co.
Insulator cups.—Bullers, Ltd.; Taylor, Tunnicliffe & Co.
Dynamos.—Belliss & Morcom.
Telegraph instruments (parts of).—Creed & Co.
Electric motors.—English Electric Co., Ltd.
Power board.—Erskine, Heap & Co., Ltd.
Switchboards.—Erskine, Heap & Co., Ltd.
Boiler tubes.—Muntz Metal Co., Ltd.; J. Wilkes, Sons & Mapplebeck; Broughton Copper Co., Ltd.; Perfecta Seamless Tube Co.; Talbot, Stead Tube Co.

POST OFFICE.

Boiler equipment, Mount Pleasant.—Fraser & Fraser, Ltd.
Pipework with accessory plant, ditto.—Foster Bros., Ltd.
Boiler plant, Leafield Wireless Station.—Babcock & Wilcox, Ltd.
Electrical equipment, Mount Pleasant sub-station.—Siemens Bros. Dynamo Works, Ltd.
Cables for ditto.—Pirelli-General Cable Works, Ltd.
Engine and electrical plant, Leafield Wireless Station.—W. H. Allen, Son and Co., Ltd.
Laying conduits and manufacturing, supplying, drawing-in and jointing cables in P.O. engineering districts as follows, for six months from November 21st, 1919 :—
Scotland, N. & N.E.—Siemens, Bros. & Co., Ltd.
N.W. & S. Lancashire.—Callender's Cable & Construction Co., Ltd.
N.W.a, S.W.a, & N. Mld.; S.W., S. Mid., E. & S.E.—Western Electric Co., Ltd.
London (cabling only).—W. T. Henley's Telegraph Works Co., Ltd.
Laying short lengths of conduits, &c., Hammersmith, &c.—J. A. Ewart, Ltd.
Laying ducts, Esher.—Greig & Matthews.
Laying ducts and pipes, Hop-East junction work.—J. A. Ewart, Ltd.
Acton (Horn Lane).—Hardy & Co.
Laying pipes, St. Thomas Street, S.E.—J. Mowlem & Co., Ltd.
Manufacturing, supplying drawing-in and jointing cable :—
Kensington exchange; Western exchange.—W. T. Henley's Telegraph Works Co., Ltd.
London-Manchester (Derby, Hazel Grove).—B.I. & H. Cables, Ltd.
London-Manchester (Old Stratford-Leicester).—Johnson & Phillips, Ltd.
Hornsey-Muswell Hill.—Western Electric Co., Ltd.
Repairing battery, Gerrard Telephone Exchange.—Hart Accumulator Co., Ltd.
Protective apparatus.—International Electric Co., Ltd.; British L. M. Ericsson Co., Ltd.; Western Electric Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L. M. Ericsson Manufacturing Co., Ltd.; North British Rubber Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—B.I. & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Connollys (Blackley), Ltd.; Johnson and Phillips, Ltd.; Macintosh Cable Co., Ltd.; New Gutta-Percha Co., Ltd.; Siemens, Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Telephone cords.—Siemens, Bros. & Co., Ltd.; Phœnix Telephone and Electric Works Co., Ltd.
Earthenware ducts.—Albion Clay Co., Ltd.; Sutton & Co.; J. Woodward, Ltd.; T. Wragg & Sons, Ltd.
Insulators.—Bullers, Ltd.
Telephone lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Motor generators.—Crompton & Co., Ltd.
Cable plugs.—Siemens, Bros. & Co., Ltd.
Insulator spindles.—Bullers, Ltd.
Insulated tails.—Siemens Bros. & Co., Ltd.
Copper wire.—B.I. & Helsby Cables, Ltd.; Wilkes, Son & Mapplebeck, Ltd.
Enamelled and silk-covered wire.—Concordia Electric Wire Co., Ltd.
Flame-proof wire.—Macintosh Cable Co., Ltd.; Western Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Fittings for Siemens' meters.—Guest & Chrimes, Ltd.
Tramway track rails.—W. Jones.
Switchboard, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone material.—British L.M. Ericsson Manufacturing Co., Ltd.

Ipswich.—Town Council :—

One 3,000-KW. Ljungström type steam turbo-alternator, with condensing plant, wet-air filter, &c., £94,675.—Brush Electrical Eng. Co., Ltd.

Stirling.—Town Council :—

Electrician's work for a year.—Lockhart & Macnab.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, January 2nd. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Automatic Electric Weighing Machines, as used with Machine Packers," by Mr. A. V. Sims.

Royal Institution of Great Britain.—Saturday, January 3rd. At Albemarle Street, Piccadilly, W. At 3 p.m. Xmas lectures on "The World of Sound" (III); "Sounds of the Country."
Tuesday January 6th. (IV) "Sounds of the Town."
Thursday, January 8th. (V) "Sounds of the Sea."
Saturday, January 10th. (VI) "Sounds in War."

Chief Technical Assistants' Association.—Saturday, January 3rd. At 3 p.m. At Anderton's Hotel, Fleet Street, E.C. Resumed discussion on "Improving the Thermal Efficiency of Generating Stations," by Mr. H. F. J. Thompson.

Liverpool Engineering Society.—Wednesday, January 7th. At the Royal Institution, Colquitt Street. At 8 p.m. Adjourned discussion on Mr. H. T. Newbiggin's paper on "The Science and Art of Lubrication."

Institution of Electrical Engineers. — Thursday, January 8th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Failures of Turbo-generators and Suggestions for Improvements," by Mr. J. Shepherd.
(Preston Sub-Centre.)—Monday, January 5th. Address on "Electric Traction," by Col. O'Brien.

Electro-Harmonic Society.—Friday, January 9th. At 8 p.m. Holborn Restaurant. Smoking Concert.

Magnetic Separators.—An interesting series of articles dealing with magnetic separators is being published in *Le Génie Civil*. The first appeared in the issue dated December 13th, and gives a good deal of valuable information regarding the permeability of various ores, &c. The articles give exhaustive details and diagrams of several types of separators.

NOTES.

Parliamentary.—ROYAL ASSENT.—The following Acts have received the Royal Assent :—

Trade Marks Act, 1919.
Patent and Designs Act, 1919.
Workmen's Compensation (War Addition) Amendment Act, 1919.
Electricity (Supply) Act, 1919.
Shropshire, Worcestershire and Staffordshire Electric Power Act, 1919.

Appointments Vacant.—Tramway general manager (£800, rising to £1,000), electrical engineer (£1,000, rising to £1,250) for the Cardiff Corporation; mains engineer (£340) for the Sunderland Corporation electricity department; engine-driver (72s.) for the County Asylum, Rainhill; switchboard attendant (98s. 4d.) for the Stockport Borough Council electricity works; charge hand for the Gellygaer Urban District Council electricity department; commercial assistant to the borough electrical engineer and chief clerk (£306) for the Stoke-on-Trent Corporation electricity department; assistant engineer (£350) for the Willesden Urban District Council electricity department. See our advertisement pages to-day.

Wireless Telephone Receivers.—A comprehensive study of the telephone receivers used in wireless telegraphy and telephony is in progress at the Bureau of Standards, Washington, D.C. The tests include measurements to determine the loudness of response given by different types of telephones, as well as the electrical characteristics which determine how satisfactorily they fit the electrical apparatus in which they are used. Accurate methods are being devised for these measurements. It is expected that observations will be made by a large number of persons, so as to express results in terms of the average ear, and also to use an electrical artificial ear, and determine the relation of the average ear to this device which will then serve as a standard. The results should make it possible to determine which type of receiver is required in a given wireless apparatus in order to obtain the loudest signals. The methods developed will be of value in making measurements of the strength of signals received, and will be utilised in connection with a study of the properties of electrical waves.

Electric Ship Welding.—The report of Lloyd's Register of Shipping for 1918-1919 states that arrangements have been made for experiments and tests to be carried out by Dr. Marchant, Professor of Electrical Engineering at the University of Liverpool, in connection with electric welding, in order to ascertain the best electrical conditions to be employed in the process of arc welding, and also to determine whether the variations in the current and voltage across the arc during welding can be used as a criterion of the satisfactory nature of a weld after it has been completed. In 1917 Lloyd's Register arranged for an exhaustive series of tests to be carried out under the direction of the society's chief ship surveyor, to determine, as far as possible, the general trustworthiness of structional connections effected by electric welding, and their capacity to withstand the strains to which they would be subjected. The results of the experiments made were considered by the Technical Committee of the society, and on its recommendation, as a tentative measure, provisional rules for the classification in Lloyd's Register book of vessels electrically welded, subject to the notations "Experimental" and "Electrically welded," were adopted. The committee also formulated its requirements regarding the tests to be complied with by all systems of electric welding for which approval was desired, and a notice was issued stating that the committee was prepared to consider applications from any electric welding companies for their processes to be recognised by the society for use in ship construction, and for their names to be inserted in a list of companies whose processes have been approved as fulfilling the society's conditions. (We described the first electrically-welded ship built in this country in our issue of August 9th, 1918.)

Plans for the first vessel in which the butts, seams and other connections are to be electrically welded have been submitted, and approved by the committee. This vessel, about 150 ft. in length, in which the use of rivets will be entirely dispensed with, is now nearly ready for launching.

Armstrong-Whitworth's New Locomomotive Works.—One of the most interesting instances of reconstruction work on Tyneside is the conversion of the Scotswood munition works into a locomotive works. When the armistice was signed the works, which formed an important part of the great Elswick Arsenal, and covered an area of 35 acres, were occupied by some 4,000 machines for the production of shells, but the moment military operations ceased, the removal of the whole of these machines was begun, and others requisite for locomotive engine-construction were installed. It was a great undertaking, but so promptly was it done that within a year the first locomotive was built, tested, and ready for delivery.

The point of outstanding interest to electrical engineers, however, is the very extensive use that has been made of electrical energy, the installation having been reconstructed in the last nine months. The energy is obtained from the Newcastle-upon-Tyne Electric Supply Co., in bulk, off its 6,000-volt system, and this is led into four sub-stations at various parts of the works. These sub-stations have duplicate feeders laid between them, forming a ring main on the works supply. The E.H.T. cables are connected to "Reyrolle" ironclad wall-operated type switchgear, so arranged that half of the installation can be isolated for overhaul. Transformers, each of 1,000 K.V.A. capacity are arranged in banks at three of the sub-stations, reducing the pressure to 440 volts. The energy is distributed by three-core L.C. and A. cables to the various shops, being controleld by medium-pressure ironclad switchgear of the same make as the high-pressure switchboard. Alternating current is used throughout for heavy power requirements, driving compressors, hydraulic pumps, cranes, shafting, &c. For lighting, separate transformers reduce the pressure to 110 volts. High-candle-power half-watt lamps are used throughout for general lighting, a standard of 4-ft. candles being maintained, while local lighting for inspection purposes is provided for all machines requiring it.

A fourth sub-station is used for converting the supply of alternating current to direct current, by means of Westinghouse rotary-converter sets, each of 750 KW. capacity. The D.C. is distributed to the machine shops at a pressure of 480 volts, and is principally used for driving motors where variable speeds are required, including Lancashire drive combinations for planing machines, frame-slotting machines, slab milling machines, triplex and duplex drilling machines, boring and turning mills, plate and angle-bar straightening and bending machines, cold saws, and wheel turning machines, electro-hydraulic wheel presses, "Tasca" angle-face grinding machines, axle grinding machines, magnetic chucks and tables, portable drills and grinders, &c. The starting gear and control mechanism is invariably of the cast-iron pillar type with remote control, push-button operation on the larger machines to facilitate handling. Metering of the energy used on the various operations is provided for, so that costing of each stage of the work can be obtained.

Two novelties introduced are a rivet-heating machine made by the firm, and a machine of Messrs. Armstrong Whitworth's own invention for horizontal grinding, in which the articles are held in position by means of magnetism.

The whole of the electrical work involved in the change over of the works was carried out by the firm's own electrical department, with the exception of connecting the high-pressure mains to the switchboard, which was carried out by the supply company.

The first locomotive completed was a 0-8-0 super-heated engine for the North-Eastern Railway Co., built from the designs of Sir Vincent L. Raven, chief mechanical engineer of the railway. Fifty of these engines are to be constructed. When the works are in full swing, between 6,000 and 7,000 men will be employed, and the erecting shop has a capacity which will permit 70 engines to be built at one time, of which 36 could be of the main-line type.

Electrical Detection of Subterranean Oil.—It is stated that crude petroleum has been located electrically in the shallow oilfield near Corsicana (Texas), and that further tests are being made around Burkburnett. A series of batteries is used for the test, the negative terminal being connected to a wire which is dropped into a dry waterhole, valley, or indentation, and the positive terminal is connected to a "land wire," which is used to make contact at various points on the surface of the field investigated. It is stated that the higher electrical resistance of oil, compared with other constituents of the earth, permits it to be located by the reduced deflection of a sensitive instrument in the circuit.—*Electrical Review*, Chicago.

Society of Technical Engineers.—A mass meeting of members, at Manchester, on December 19th, was addressed by Mr. E. Murray-Wrong, who took as his subject "The Value and Purpose of Organisation." He explained to the meeting that he was speaking from the point of view of one outside the society, and he did not possess any special knowledge of the society's objects. The speaker then gave his views of trade unions and similar organisations, and pointed out that contrary to earlier social doctrines these did not restrict individual liberty, but provided a speaking medium through which the individual might express his ideals. It had been considered that trade unions necessarily involved class warfare and unrest, but this was chiefly due to ignorance of the functions of such bodies. Their main object was negotiation, and the strike was only resorted to when negotiations failed.

Mr. Murray-Wrong considered that the society had many difficulties to contend with. At one end of the scale it graded almost imperceptibly into Labour, and at the other into Capital. The society had therefore to guard against two possibilities. There might be an attempt to use it as a "balance of power" between Capital and Labour—a policy which meant failure. Again, the organisation might tend to become an appendage of Capital, thereby alienating labour and limiting the society's sphere of action. In the speaker's opinion, the best course to pursue would be for the society to associate itself with the labour movement generally, sending representatives to conferences and other similar gatherings. This would secure a public hearing, and make it possible to influence public opinion, which was the main purpose of such an organisation.

Upon the conclusion of the address a number of members took part in a discussion of the subject.

The Electric Smelting of Tin.—In No. 99 of the *Revue d'Electrochemie et d'Electrometallurgie* an account is given by Prof. Jean Escard of the treatment of tin ores in the electric furnace. The author states that an electrical efficiency of 55 per cent. or more can be attained, and the electric furnace produces pure tin with continuous operation, which is not possible with the reverberatory furnace. The former, moreover, requires only 14 per cent. of carbon for reduction, as compared with 20 to 25 per cent., employs less labour (only three men per furnace), and consumes the electrodes so slowly that their cost is negligible. Where waterfalls exist in the neighbourhood of tin mines, and coal is dear, the electrical process presents marked advantages. Charcoal can be used for reduction. The energy consumption per ton of tin is about 1.140 KW.-hours. The furnace is of the "shaft" type, with three electrodes. Similarly, the electric furnace (of the resistance type) can be applied to the recovery of tin from scrap metal with a high commercial efficiency.

Inquiry.—The name and address of the glass shade manufacturers or factors known as "W. F. Co., Ltd.," is wanted.

Diesel Engine Users' Association.—At the December meeting of the Diesel Engine Users' Association Mr. Chas. Gould, A.M.I.E.E., electrical engineer to the First Garden City, Ltd., Letchworth, was elected president for the ensuing year, and Mr. Percy Still, M.I.E.E., M.I.Pet.Tech., chief engineer and manager to the Chelsea Electricity Supply Co., Ltd., was re-elected hon. secretary. Messrs. Geoffrey Porter, A.M.I.nst.C.E., and A. W. A. Chivers were elected members of the General Committee, in place of the two members who retire. The present members of the Standing Committee on Insurance, which deals with any question arising in connection with the standard policy of insurance against breakdown at Lloyds which has been approved and adopted by the Association, were all re-elected for a further term of office. The Hon. Secretary made his annual statement, referring to the further growth in the membership of the Association, and the subjects dealt with and work carried out during the year.

Theatre Electricians.—As the result of a Conference with the Parliamentary Committee of the Trade Union Congress on December 30th an agreement was reached between the National Association of Theatrical Employés and the Electrical Trades Union in regard to a dispute between the two organisations. There had been trouble with the Electrical Trades Union over the attempt of that society to enrol theatrical electricians and kinema operators. The agreement signed by representatives of both Unions and the Parliamentary Committee runs thus:—

"That the N.A.T.E. and the E.T.U. agree to recognise each other's membership card in the entertainment industry. That each Union undertakes not to induce a member of the other Union to leave one Union for the other. That when any question arises affecting the conditions of employment of members of either Union employed in the entertainment industry both Unions agree that the section so affected shall have the support of all other sections belonging to either Union.

"That, with regard to members of either Union, employed in the entertainment industry, joint action be taken to promote a joint programme for all members of either Union so employed, in any area. That immediate steps be taken to promote a joint programme for those employed in picture theatres."

Educational.—The Electricity Committee of the Willesden Urban District Council has had under consideration a scheme submitted by the electrical engineer for providing a graduated course of training in electrical engineering for boys residing in the district. This scheme is the outcome of many applications which have been received for the training of lads in this manner, and the Committee is of the opinion that it would be advantageous to the Council and to the inhabitants of the district if it were brought into operation. It, therefore, recommends that the scheme as drafted be approved in principle.

The Patent Office Library.—The library is now open daily, from 10 a.m. to 8 p.m., except Sundays, Good Fridays, Christmas Day, and Bank Holidays. On Christmas Eve, Easter Eve, and Whitsun Eve the library will close at 4 o'clock. As announced in our "Correspondence" columns on December 12th, Mr. C. Salter, of 33, Park Hall Road, London, N. 2, is promoting a petition to the President of the Board of Trade with a view to extending the hours to 10 p.m., and will be glad to hear from readers who will support the movement.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The December issue of the *Journal* announces the following arrangements for January, 1920:—

Ordinary Meetings of the Institution.—(To be held at the Institution of Civil Engineers, Great George Street, Westminster, at 6 p.m.)

January 8th. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 22nd. "Transformers for Electric Furnaces," by J. L. Thompson, M.Sc.

Meetings of Territorial Centres.—January 6th, Preston. "Electric Traction," by H. E. O'Brien, D.S.O.

January 12th, Newcastle. "Scientific Management," by J. M. Scott-Maxwell.

January 13th, Edinburgh. (To be announced later.)

January 13th, Leeds. "Large Power Transformers," by A. G. Ellis and J. L. Thompson.

January 13th, Manchester. (To be announced later.)

January 14th, Birmingham. "Eddy Current Losses in Stator Windings," by H. W. Taylor.

January 15th, Birmingham. Joint meeting with Midland Junior Gas Association.

January 19th, Liverpool. Address by Prof. E. W. Marchant, D.Sc. (Inaugural Meeting of Liverpool Sub-Centre.)

January 26th, Newcastle. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 27th, Manchester. (To be announced later.)

January 28th, Birmingham. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 30th, Newcastle. Annual dinner of North-Eastern Centre.

STUDENTS' SECTION.—January 16th. City and Guilds Engineering College, South Kensington, S.W. (7 p.m.), "The Development of Automatic Telephony," by J. H. Reyner.

IRISH CENTRE (BELFAST).—The following have been appointed to form a Preliminary Committee to take the necessary steps to inaugurate this Centre:—Messrs. T. W. Bloxam, E. S. Dashwood, R. V. Macrory, F. W. Parkinson, H. D. Wight, and Prof. R. Stanley (acting hon. secretary).

SCHOLARSHIPS.—The Council has awarded the following Scholarships for 1919-20:—

Salomons Scholarships (value £50 each).—To Mr. J. C. Read, of Bristol University; and to Mr. H. J. Barriscale, of the Engineering School, University College, Cork.

David Hughes Scholarships (value £50 each).—To Mr. D. S. Anderson, of the Royal Technical College, Glasgow; and to Mr. B. A. Cronin, of the University College of South Wales and Monmouthshire.

Paul Scholarship (value £25).—To Mr. F. E. Price, of the Finsbury Technical College.

THE INSTITUTION OF ENGINEERS (INDIA).—The I.E.E. Council has awarded for the next five years, an annual prize of £20 for the best paper on an electrical subject read before the above Institution.

The *Journal* also gives a complete list of the Committees appointed by the Council for 1919-20, and the names of the Institution's representatives on other bodies.

The SCOTTISH CENTRE is holding a conversazione on February 4th, 1920, at St. Andrew's Hall, Granville Street, Glasgow.

Society of Technical Engineers (North-Eastern District).—The following meetings will be held during the current month, commencing at 7 p.m.:—

Sunderland.—Wednesday, January 14th, at the Subscription Library, Fawcett Street.

Middlesbrough.—Friday, January 16th, at the Corporation Hotel.

Newcastle-on-Tyne.—Wednesday, January 21st, at the City Hotel.

Belfast Association of Engineers.—"Wireless Communication in the War" was the title of a lecture given by Major Rupert Stanley, at Belfast, on December 18th. The lecturer, in the course of his address, which was illustrated by lantern views, dealt with the transmission and reception of wireless messages, wireless equipment for military purposes in the earlier phases of the war, the evolution of the hard valve and its advantages in wireless communication, the complete system of wireless communication employed in France in 1918, and the latest achievements in wireless signalling, telephony, and long-range work. Major Stanley was an instructor and experimental adviser to the British Expeditionary Force in France. In acknowledging the vote of thanks, Major Stanley said that the Allied triumph over the Germans in wireless work was largely due to the achievements of the French wireless experts.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. E. JORDAN, of Northampton, has been appointed shift engineer at Rawtenstall Electricity Works.

Mr. A. W. COOPER, of the Electricity Works, Walthamstow, has been appointed meter charge engineer at the electricity works, London Road, Southend-on-Sea.

Captain and Adjutant D. A. WILLIAMSON, Tyne Electrical Engineers, has vacated the appointment of adjutant on ceasing to be employed.

Lieutenant W. G. C. HARDY, City of Edinburgh Electrical Engineers, has vacated the acting rank of captain on ceasing to be employed.

Commander J. P. SCHOFIELD, M.B.E., Principal of the Cardiff Wireless College, has been presented by the students with a silver cruet set. The college turned out 1,000 wireless operators during the war.

At a smoking concert held at the Manchester Hotel, Hull, on December 19th, Mr. J. WILKINSON, who recently retired from the position of Corporation tramways electrical engineer, after nearly 20 years' service, was presented by Mr. J. W. A. Renton, supervising engineer, on behalf of the tramways department employés, with an Underwood typewriter and an umbrella. It is stated that Mr. Wilkinson is now introducing electrically propelled battery vehicles into Hull.

Mr. F. H. RUDD, electrical engineer to the Rochdale Corporation, has not yet recovered from a nervous breakdown, and on the advice of his doctor, is taking a further rest and change of surroundings. The Gas and Electricity Committee last week expressed their sympathy with him, and granted him a further two months' leave of absence. The committee feel that the breakdown of Mr. Rudd's health is due to the trying time he has had since he took control of the undertaking nearly three years ago. He has been faced with a great many difficulties, often being at the works for 48 hours at a stretch.

On the occasion of his leaving the Aberdeen Corporation Electricity Department to take up duty as shift engineer with the Falkirk Corporation, Mr. H. THOWSDALE, on December 26th, was made the recipient of a watch and chain as a parting gift from his fellow employés. Mr. Bullman, station engineer, in the absence of Mr. Bell, made the presentation.

The *Birmingham Post* states that the services rendered to Birmingham and the district by Sir Oliver Lodge and Lady Lodge were to be recognised by the presentation of an address and a memento to them at a meeting of the subscribers to be held at the Council House on January 1st. The list of contributors was closed on December 31st.

On the occasion of his leaving the Surbiton Electricity Supply system to take up another appointment, Mr. A. W. CRICK, who has been a member of the staff for the past 16 years, was presented with a suit case.

Alderman G. PEARSON, chairman of the Bristol Corporation Electricity Committee, who has for the past 14 years acted as honorary solicitor to the Incorporated Municipal Electrical Association, has recently, much to the regret of the Association, been compelled to resign owing to indifferent health. The Council of the I.M.E.A. have pleasure in announcing that Mr. P. M. Heath, deputy town clerk of Manchester, has consented to accept this position.

Acting Captain J. A. SLEE, C.B.E., R.N., has been appointed technical superintendent and adviser on the staff of the Marconi International Marine Communication Co., Ltd.

Obituary.—MR. CLAUD HAMILTON.—The death took place at Sidmouth, Devon, where he was on holiday, of Mr. Claud Hamilton, of Claud Hamilton, Ltd., electrical engineers, Glasgow and Aberdeen. Mr. Hamilton, who came of an old engineering family, took up that profession and served his apprenticeship with Messrs. A. & J. Inglis, Glasgow, and Messrs. J. & W. Abernethy, Aberdeen. When the latter business was incorporated as a limited company, he became a director. In the late '80's he founded the business of Claud Hamilton, which, under his direction, became one of the most extensive concerns of its kind in Scotland.

MR. W. HOPEKIRK.—The death is announced, at the age of 74 years, of Mr. W. Hopekirk, electrical engineer, of Hawick.

NEW COMPANIES REGISTERED.

Perna Engineering Works (Blackpool), Ltd. (161,690).—Private company. Registered December 15th. Capital, £3,000 in £1 shares. Objects: To take over the business carried on at Castlegate, South Shore, Blackpool, as the "Perna Engineering Works," and to carry on the business of general and electrical engineers, manufacturers of Perna electric-dynamo lighting sets and other Perna specialities, builders and makers of motor bodies, chassis, &c. The subscribers (each with one share) are: G. H. Morris, 39, Central Drive, Blackpool, contractor; W. S. Pyrah, 3, Alexandra Road, South Shore, Blackpool, engineer; R. H. Mann, 20, Osborne Road, South Shore, Blackpool, engineer. The first directors are: G. H. Morris, W. S. Pyrah, and R. H. Mann. Registered office: Castlegate, South Shore, Blackpool.

British Brass Fittings, Ltd. (161,968).—Registered December 22nd. Capital, £350,000 in £1 shares. Objects: To take over the businesses of Sperryn & Co., Ltd., Chas. Joyner & Co., Ltd., Ingram & Kemp, Ltd., and Player & Mitchell, Ltd., with certain of the assets thereof (the purchase considerations being respectively £95,644, £43,395, £28,164 and £33,872), and to carry on the business of brass and iron founders, water, gas, oil and electric fittings manufacturers, &c. The first directors are: G. Sperryn, Hampton Grange, Solihull, director of Ingram & Kemp, Ltd., and Sperryn & Co., Ltd.; G. M. Sperryn, 25, Wycliffe Road, Handsworth, director of same companies; H. B. Butler, Meadow View, Stratford-on-Avon, director of Butlers, Ltd.; D. B. Grubb, High Croft, Alvechurch, director of Klore Sheep Farming Co., Ltd.; W. J. G. Sperryn, 45, Frederick Road, Wylde Green, Birmingham, director of Ingram & Kemp, Ltd.; W. Dampier, Park Mount, Strencham Hill, Moseley, Birmingham, director of Player & Mitchell, Ltd. Acting secretary: H. B. Butler. Solicitors: Brooks, Monk and Hargreave, 37, Waterloo Street, Birmingham.

C. H. Davies & Co., Ltd. (161,802).—Private company. Registered December 18th. Capital, £12,000 in £1 shares (2,000 6 per cent. cumulative preference). To take over the business of an electrical accessories manufacturer carried on by C. H. Davies at 153, Bracebridge Street, Birmingham. The subscribers (each with one share) are: C. H. Davies, 153, Bracebridge Street, Birmingham, electrical engineer; T. Gladdy, 155, Bracebridge Street, Birmingham, electrical engineer; T. Reynolds, 155, Bracebridge Street, Birmingham, mechanical engineer. The first directors are: C. H. Davies, T. Gladdy and T. Reynolds. Solicitor: E. F. Freeland, Birmingham.

British Electrical Repairs, Ltd. (161,905).—Registered December 20th. Capital, £50,000 in £10 shares. Objects: To carry on business as indicated by the title. The first directors are: J. J. Atkinson, 1, North John Street, Liverpool; H. C. Evans, 18, Exchange Street, Manchester; N. Fletcher, Eden Brows, Armathwaite; L. V. Gerrard, 24, Fennel Street, Manchester; H. M. Longridge, 24, Fennel Street, Manchester; N. H. Maxwell, 1, North John Street, Liverpool; H. F. Taylor, 56, Kingsway, W.C.2. Registered office: 24, Fennel Street, Manchester.

Sutton-in-Ashfield Motor and Electrical Engineering Co., Ltd. (161,841).—Private company. Registered December 18th. Capital, £20,000 in 19,950 preferred ordinary shares of £1 each and 1,000 deferred ordinary shares of 1s. each. To carry on the business indicated by the title, and to adopt an agreement with R. Fenna. The subscribers (each with one preferred ordinary share) are: J. B. Hole, Redbank, Mansfield, Notts, gentleman; B. Walton, jun., 74, Kirkby Road, Sutton-in-Ashfield, Notts, hosiery manufacturer. The first directors are: J. B. Hole and B. Walton, jun. (both permanent, subject to holding 100 deferred ordinary shares each). Qualification of ordinary directors, £500. Registered office: Bank Chambers, Sutton-in-Ashfield.

British Aris Sparking Plug Co., Ltd. (161,966).—Private company. Registered December 22nd. Capital, £5,000 in £1 shares. Objects: To carry on the business of manufacturers and importers of and dealers in sparking plugs and all kinds of mechanical or electrical machinery, engineers, turbines, dynamos, &c., and to enter into an agreement with Société Aris of 33, Rue de l'Abondance, Lyons, France. The subscribers (each with one share) are: J. P. Edmunds, White Lodge, Whitchurch, Glam., director and shipowner; H. H. Deacon, "Coedmor," Penarth, colliery agent. Permanent directors are: J. P. Edmunds, H. H. Deacon, F. H. Bridge, A. S. Shedden, H. J. Edmunds and A. L. Rhys-Evans. Qualification, £100. Secretary: A. L. Rhys-Evans. Registered office: 65-8, Merchants' Exchange, Bute Docks, Cardiff.

Appareil Magnetique Co., Ltd. (161,796).—Private company. Registered December 18th. Capital, £4,000 in £1 shares. To take over the business of a company of similar name, and to carry on the business of medical electricians and magneticians, manufacturers of electrical, surgical and calisthenic appliances, sports goods, &c. The subscribers (each with one share) are: H. F. Perry, 8, Park Grove Road, E.11, cashier; G. C. Baldock, 54, Strowe Road, E.7, solicitor's clerk. Managing director: G. Petterson. Registered office: 2, Charterhouse Street, E.C.

B. K. E. Electric Motors, Ltd. (161,749).—Private company. Registered December 17th. Capital, £20,000 in £1 shares. To carry on the business of buyers and sellers of and dealers in all kinds of vehicles, ships and vessels (whether propelled or moved by electricity, steam or other power) and all electric or other motors, &c. The subscribers (each with one share) are: C. E. W. Ogilvie, 32, Essex Street, Strand, W.C., solicitor; W. R. Bradshaw, 32, Essex Street, Strand, W.C., clerk. The subscribers are to appoint the first directors. Qualification, £500. Solicitor: C. E. W. Ogilvie, 32, Essex Street, Strand, W.C.2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Power Engineering Co., Ltd.—Debentures for £500 registered November 14th, 1919, part of £11,500, charged on the company's undertaking and property, present and future, including uncalled capital.

Rushmores, Ltd. (formerly Rushmore Lamp Works, Ltd.)—Satisfaction registered November 12th, 1919, (a) to the extent of £27,500, of charge for £30,000 registered December, 1917, and (b) in full, of charge for £1,002, and other moneys registered August, 1919.

English Electric Co., Ltd.—Debentures for £1,000,000 (secure by trust deed dated September 15th, 1919) charged on interests in various shares and in certain freehold works at Preston and Bradford, and the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Co., Ltd.

At the meeting held on December 17th, Sir J. Denison Pender first referred to the death of Mr. F. A. Bevan, who had been a director since 1873. Turning to the accounts, he said that these were very satisfactory as the gross receipts for 1918 showed an increase of £562,000, due to the enormous increase of traffic all over the company's system. The working and other expenses showed an increase of £68,000, mainly accounted for by additions to the staff salaries and war payments. A revaluation of their securities showed that the provision made in past years on account of investment fluctuations was found to be practically sufficient to meet the depreciation of the reserve fund securities on December 31st, 1918, when the accounts were made up. At the meeting of the Eastern Co. he had gone very fully into the causes of delays on traffic. He would not go over the ground again, and they would receive a full report of that meeting. As an illustration of the enormous growth of traffic since the outbreak of war he mentioned that the trans-Indian and this company's local traffics between India and the Far East, &c., showed an increase in 1918 of roundly 327 per cent. over the pre-war year 1913. Consequently, additional carrying capacity was urgently required to deal with this large volume of traffic, and they were making arrangements for the manufacture and laying of a new cable between Madras and Singapore at the earliest possible moment. The Eastern and other cable companies also urgently needed more cables to meet their traffic requirements, and it would, therefore, take some little time before this could be effected. The money required for the Madras-Singapore cable would be taken from the general reserve fund.

Ward and Goldstone, Ltd.

At the statutory meeting, held at Manchester on December 18th, Mr. M. H. Goldstone, who presided, said that the state of the order book was very healthy; in fact, they were booked up at profitable rates in most departments for a long time ahead. The demand for wires, cables, and flexible cords, continued in excess of the supply. Not only was there a continued increasing demand for cables for lighting, heating, power, telephone and bell service, but

the automobile industry requirements were very substantial, and the directors were making provision in the new works for increasing the output. In the departments relating to switch and fuse gear, owing to the heavy stocks of castings they usually carried, they had as yet not been seriously handicapped by the moulders' strike, but unless this trouble was soon settled, they feared that this department was likely to suffer. Almost every branch of the engineering industry was dependent upon obtaining supplies of castings. The demand for their electrical plants for lighting country houses, bungalows, cinemas, &c., was growing, and they looked to this department to supplement their profits to a considerable extent. Referring to the competition of American and other makers, he said that they had little fear of fair competition in lighting sets. They were anxious to remove to the new works, particularly as the congested state of the present stores and warehouse was restricting turnover. They hoped to start moving in April of 1920, and as it was intended, as far as possible, not to stop production during removal, they were duplicating a portion of the machinery. It was anticipated that by a year hence they would be finally installed in the new works, when they would be able to cope more successfully with the large amount of business offered. The turnover of the company continued to increase satisfactorily. The directors were optimistic as to the future prospects of the company, providing that they could steer clear, as they had done in the past, of labour trouble.

Eastern Telegraph Co., Ltd.

Presiding at the annual meeting, held at Electra House, E.C., on December 17th, Sir J. Denison Pender made some comparisons to illustrate the growth of business during the war and since the signing of the armistice. The gross revenue for the year 1913 was £1,462,844. For 1917 it was £2,901,579, an increase of £1,438,735, or 100 per cent. For 1918 the gross revenue was £463,470 in excess even of 1917, and £1,902,205 above the pre-war figure. On the other hand, the total expenses had correspondingly increased, and large payments had accrued to the Government for excess profits duty and income tax, the result being that, notwithstanding the increase in the gross revenue over 1917 of £463,470, the amount available for reserve and dividend on the ordinary stock was roughly £20,000 less than in 1917. The amount charged in the accounts under review for income tax and excess profits duty payable in England was £861,300, and the amounts paid and due to the Government from this and their associated companies for the last five years totalled no less than six million pounds. Special attention should be drawn to the expenses attending maintenance of cables, £364,807. This work now involved great expense owing to additional cost of cable and materials, higher labour charges, and all the other items relating to the upkeep and running expenses of ships. The average annual cost of this item for the five years prior to the war was £107,021. Although their men had necessarily to run risks in repairing cables during the war, they did not lose a ship, although the whole fleet was at work practically night and day. The naval authorities realised the vital importance of maintaining telegraphic communication throughout the Empire, and it was a great satisfaction to the company to render important service to both the naval and military authorities by laying, maintaining, and working many strategic sections, as well as maintaining a satisfactory service for Government correspondence. The combined interests of this country and the Allies were their first consideration, and, although regular customers were subjected to many restrictions and their commercial service was hampered, they did everything possible to provide the best service obtainable during the war. Unfortunately, the commercial service still fell short of the high state of efficiency which existed before the outbreak of war, and public telegrams were subject to serious delay. They were doing everything possible to improve matters. That they would succeed in again attaining their pre-war standard there was no doubt whatever, but it must necessarily take time. Prior to August, 1914, the routes owned by the Indo-European and by the Great Northern Telegraph Companies, which passed through Germany and Russia, dealt with approximately 40 per cent. and 30 per cent. of the Indian and Far East traffic respectively, and since that date this company had had to deal with practically the whole of this work in addition to their own traffics. Before the war their system of duplicate, triplicate, and in some cases quadruplicate cables, and alternative routes, which provided security against the temporary breakdown from natural causes of one or more sections, always gave a good margin of capacity over and above a likelihood of any abnormal volume of traffic which might arise from any special event of national or international interest. When the unprecedented increase of traffic with which they had to cope was suddenly thrust upon them, the whole of their previous margin of safety disappeared, and it was impossible to manufacture and lay additional cables to meet this emergency. Not only was this impossible, but it was with the greatest difficulty that they were able to maintain the cables already laid. Another factor which should not be overlooked was shortage of staff. The demand for youth to maintain the fighting forces had, naturally, the effect of cutting off the supply of suitable young men, and as it took some years of training and experience to make an efficient telegraph operator, the burden during the war was thrown upon the shoulders of those who, from age or by the wise decision of the naval and military authorities, were prevented from taking an active part in the land and sea defences of their country. The supply of suitable young men was now more satisfactory, and the strengthening of the staff was now only a question of time, but it must be remembered that some years' training had been lost. The Government telegrams exchanged with and through the United Kingdom contained on an average over 30,000 words a day, whereas in 1913 the daily average was only about 3,000 words. The total number of paid words dealt with by the companies in 1918 was about 180 millions, in addition to which they had carried during the war three million words free of charge in connection with wounded, Red Cross, &c. In 1913 the total number of words was only about 64 millions. They had hoped that with the removal of the censorship restrictions and the reintroduction of private codes, the volume of traffic would appreciably diminish. The reverse had taken place, the number of messages had increased, and their length was only slightly reduced. Not long ago two of their main line cables were accidently broken by ships' anchors, and although these were speedily restored, the accumulation due to these interruptions created serious delay, because there was no margin of capacity to deal with the congestion resulting from the interruptions. No permanent improvement could be relied upon if the traffic was maintained at its present level, until they could improve the capacity of the system by laying additional cables and introducing new apparatus, which would increase the speed of working. Neither of these means was possible during the war, as all the cable and electrical apparatus manufacturers practically devoted the whole of their energies to the output of war materials, and it would be some time yet before their requirements could be met. They had long since placed orders for both cable and apparatus, and the manufacturers were doing all they could to assist, but the unavoidable delay in delivery hampered their initiative. They made arrangements with the Ministry of Shipping to charter the *Stephan*, one of the largest cable-laying vessels in the world, which was taken over from the Germans, and she had just completed the laying of another fast speed cable between Porthcurnow, in Cornwall, and Gibraltar, about 1,200 miles in length, which would form the first section of a new main line between Great Britain and the Far East through the Mediterranean, and on *via* Bombay and Madras, then taken on by their associated company, the Eastern Extension, &c., Co., to Singapore, involving an expenditure of about 7,000 miles of cable. Provisional orders were placed immediately there was a likelihood of the cable being manufactured, and as soon as each section was delivered it would be laid and worked. In the meantime partial renewals had been and were being carried out, and other means had been devised to improve the speed of some of the existing cables. The manufacturers were also being pressed by other administrations to carry out extensive orders for cable to improve telegraphic communication in other parts of the world where there was also heavy delay. After referring to the vexed question of triple-rate urgent telegrams, the chairman said that the company was one of the few public concerns which had not raised their charges during the war. On the contrary, they had, in fact, reduced their rates since 1914 with British West Africa, New Zealand, the Dutch East Indies, Japan, South Africa, and East Africa, while reductions with China, Hong-Kong, and the Philippines would come into operation on January 1st next. Although they were always ready to reduce rates whenever circumstances warranted it, they must point out that the Governments of Great Britain and India had considered it necessary to increase their pre-war charges for local internal telegrams, and the rentals charged for pneumatic tubes and underground wires had also recently been raised, which had had the effect of considerably increasing their outpayments in Great Britain. The general reserve fund had reached £3,076,000, due to the conditions ruling during the last five years, which made it impossible to undertake necessary renewals and the laying of cables—even those which in the ordinary course would have been necessary to provide additional capacity to enable them to deal properly with the normal growth of business. Therefore, the moneys which would have been expended on this work had there been no war were invested for the time being in War Loans. When it became possible to get delivery of a part of their requirements, they laid the first link, the new Porthcurnow-Gibraltar section already mentioned. This company alone must have at least another 4,000 miles of cable as soon as they could be manufactured and laid, the cost of which would be chargeable against the general reserve fund, and as the price of cables to-day was so greatly in excess of pre-war prices the reserve fund would be materially reduced. Their reserve fund was not a "free reserve" in the sense of the reserves of other trading concerns, and could not be looked upon as available for capital distribution. It was set aside for the specific purpose of providing renewals and additional cables, &c., as required; and the withdrawals in future would be very heavy. They had ordered a new cable repairing ship capable of consuming either coal or oil fuel, and fitted with all the latest cable repairing machinery and equipment. She would be a very useful addition to their fleet. Had it not been for the moulders' strike she would have been delivered in May next, but this date could not now be adhered to. Her cost would be more than double the pre-war price.

Bullers, Ltd.—The report for the four years ended July 31st, 1919, states that during the period in which the company was a controlled establishment the directors were unable to issue reports and statements of account owing to the difficulty of arriving at accurate figures relating to munitions levy and excess profits duty. A settlement with the Government has been reached enabling balance sheets for the four years to be submitted. In order to deal with the great increase in the volume of business, new works at Milton are being erected and are nearly complete. The accounts for the years 1916, 1917, and 1918 have been adjusted and a final balance of £9,443 has been brought forward to be dealt with. For the year ended July 31st, 1916, 7½ per cent. dividend on the ordinary shares has been paid, and for 1917 and 1918 10 per cent. The reserve fund has been increased, and now stands at £90,000. The accounts, after payment of the directors' fees, salaries, &c., and after providing for excess profits duty, show a profit of £32,653. This amount, together with £9,443 brought forward, makes a total of £42,096. The directors recommend a further dividend of 7½ per cent., making 12½ per cent. for the year, on the ordinary shares; that £10,000 be placed to reserve, bringing that amount up to £100,000; a further allocation of £5,000 against contingencies at Hanley, and the balance of £846 to be carried forward.—*Financial Times.*

Companies Struck off the Register.—The following companies have been struck off the register, and are accordingly dissolved :—

British Empire Lighting and Construction Co., Ltd.
Carbo Welding Syndicate, Ltd.
Coal Carbonising Patent Syndicate, Ltd.
Electra Rubber and Vulcanite Syndicate, Ltd.
Oil Fuel Gas Generator, Ltd.
Ostro Light Co., Ltd.
Shipston Electrical Co., Ltd.

Barbados Electric Supply Corporation, Ltd.—For the year ended June 30th, 1919, the trading profit was £3,600, as against £3,197 for the previous year. £1,303 has been charged against trading for repairs and renewals, as against £484, the increase being due chiefly to the cost of renewals to Diesel engines necessitated by a breakdown which occurred subsequent to the issue of the last report

	Consumers connected June 30th.	25 c.p. equiv. connected June 30th.
1918	1,541	22,208
1919	1,646	23,034

In view of the breakdown and of the difficulty of obtaining materials of all kinds, the progress is considered satisfactory. Capital expended during the year £1,854, chiefly upon further house connections and mains additions. A 225-KW. set is being installed to meet the growing demand and to provide sufficient spare plant to admit of the systematic overhaul.

Stock Exchange Notices.—Application has been made to the committee to allow the following to be officially quoted :—

British Electric Transformer Co., Ltd.—62,500 6 per cent. cumulative preference shares of £1 each, fully-paid (Nos. 200,001 to 262,500).

Aluminium Corporation, Ltd.—£206,323 ordinary stock, and £219,512 preference stock.

The Rumanian Lahmeyer Co.—The annual report for 1918 of the Electrica Societate Romana Jost Lahmeyer, of Bucharest, states that the company was placed under Rumanian compulsory administration in December of that year. The net profits earned amounted to 237,000 lei in 1917, and 437,000 lei in 1918, dividends at the rate of 4 and 6 per cent. respectively having been declared. It is stated, however, that the dividends have not been paid, nor has the coupon due on July 1st, 1919, on the bonds, which were issued in Swiss francs, been met, the rate of exchange being unfavourable to the company.

Crompton & Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum on the preference shares for the half-year ended September 30th, 1919.

Burmah Electric Tramways & Lighting Co., Ltd.—Dividend of 10 per cent., less tax, on the preference shares for the period ended July 31st, 1919; £8,000 is placed to depreciation reserve, making it £35,894; £750 to depreciation of investments, and £492 is carried forward.—*Financial Times.*

International Light & Power Co.—Dividend of 1½ per cent., less British tax, on preference for quarter ended December 31st.

STOCKS AND SHARES.

NEW YEAR'S EVE, 1919.

HARKING back for a couple of years, it may be recalled that at the end of 1917 the interim report of the Coal Conservation Sub-committee on the supply of electric power in Great Britain was presented to the nation. That report contained drastic suggestions which had for their object the conservation of coal by amalgamation of authorities. The sub-committee estimated to save a million pounds cash and 55 million tons of coal. The scheme was regarded at that time in the Stock Exchange as being of too wide and sweeping a nature for it to become practical politics, excepting, perhaps, after the lapse of many years. Some of its suggestions found their way into the Government's Electricity Supply Bill, 1919, and, as it is scarcely necessary to recall, this Bill the House of Lords has recently put its foot upon and trodden out of shape, so far as the objectionable features were concerned. Objectionable, that is to say, from the point of view of holders of shares in electricity supply companies. Throughout the whole of the year now ending, this Bill has laid a weight upon electricity investment of every kind. It has seemed to be the fate of the industry to be dogged for the past two decades by uncertainties. Now, however, the sky, although far from clear, is rendered the less obscure by the House of Lords' action, which, however, has failed to do much in the way of reviving the drooping spirits and the drooping prices that have prevailed amongst the shares in this section throughout the past twelve months. In presenting the usual tables, we give the closing quotations which prevailed at the end of 1918 and 1919. It may be devoutly hoped that when we come to give a column to the quotations for Leap Year, proprietors will derive more refreshment from the review than they are able to draw from the present prices.

The Home Railway market is another which has been dogged by troubles throughout the period. Nationalisation, when first predicted by Mr. Winston Churchill, was hailed as a lever for raising prices, but it very soon became apparent that from the point of view of the investor, there was nothing to it, as the soldiers say, and prices again started on the slippery slope which has taken them down lower than ever. Within the past few weeks something of a rally occurred on the expectation of the railway business being substantially benefited by the rise in freights that is to come into operation a fortnight hence, so that the final quotations for the year are well above the lowest. Even so, however, there is left a string of falls, though here again the prospect in respect of 1920 is a little more cheerful.

The steady upward march of cable securities continued through the greater part of the past twelve months. With taxation likely to press yet more heavily in the spring, investors, looking ahead, again favoured securities upon which dividends are paid free of tax, and for this reason such issues as Eastern Extensions, Globe Ordinary, Western Ordinary, and Eastern Telegraph stocks with several others, are decidedly better. Great Northerns are amongst the few to show a material fall on the year, an illustration of the way in which stocks with an inter-bourse market have been affected by the dislocation of the French rate of exchange. Marconis are better than they appear, inasmuch as the present quotation is ex the value of the rights recently deducted. Various Anglo-American stocks and bonds in companies domiciled in the United States and Canada have improved, this also being due to the rate-of-exchange factor, which has worked to the advancement of such prices as those into which the value of the dollar enters as an element. Mexicans have gone back again sharply after the big rises which occurred in 1918. To take Mexico Tramways First Mortgage Bonds as an example, the price last year gained 39½ points, whereas this year it has gone back 24½. A good deal of attention has been paid to British Columbia Electric Railway stocks, and the prices, after acute falls, recovered rapidly on the much more hopeful outlook which now opens up for the company. Anglo-Argentine tramway stocks are somewhat reactionary, in spite of the expectation that it may not be long before the company is able to pay off arrears of interest on the first preference shares.

The changes amongst manufacturing shares are somewhat mixed, but, on the whole, this market has been helped not a little by the idea that if the Government's Electricity Supply Bill went through, it would benefit the undertakings to a considerable extent, and notwithstanding the House of Lords attitude, the improvements secured by manufacturing issues have been well held. The loss of the Anti-Dumping Bill in the House of Commons caused some little speculation as to how far this may be likely to affect companies that were most likely to be helped by a policy of active protection. The lists of prices make an interesting study :—

HOME ELECTRICITY COMPANIES.

Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.		Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.
Brompton ..	7¾	5⅞	— 1⅞	London	1⅜	1⅜	— ⅛
Charing Cross ..	3⅜	2¾	— ⅝	Metropolitan ..	3	3	—
Chelsea	4	3	— 1	St. James' ..	7½	6	— 1½
City of London ..	13	12	— 1	South London ..	3	2⅛	— ⅞
County of London	11½	9½	— 1⅞	Westminster ..	7½	5½	— 2
Kensington ..	5⅞	4⅞	— 1⅛				

TELEGRAPHS AND TELEPHONES.

Ang.-Am. Pref. ..	99	90½	— 8½	Indo-European ..	58½	48½	—10
Cuba Submarine	10⅛	10⅛	—	Marconi	4⅞	4⅛	+ ⅛
E. Extension ..	15½	16¼	+ ¾	United R. Plate..	7⅛	7⅛	— ⅛
E. Telegraph ..	157½	168½	+11	W. India & Pan.	1⅛	1⅛	— ⅛
Globe Tel. Ord. ..	14⅛	15⅜	+ 1⅛	Western Teleg. ..	16½	17½	+ 1
Great Northern ..	38	28½	— 9½				

HOME RAILS.

Cen. Lon. Assen.	65½	58½	— 7	Under. Ord. ..	3⅜	2½	— ⅞
Metropolitan ..	31½	25½	— 6	do. "A" ..	8/0	6/6	—2/6
Met. District ..	26	21	— 5	do. Income .	99½	81	— 5½

FOREIGN TRAMS., &c.

Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.	Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.
A. Arg. Tr. 1st Prf.	4 1/16	3⅜	— 11/16	Mex. Trams. 1st	67	42⅜	—24⅛
Brazil Traction..	57	60½	+ 3½	Mex. Light Com.	38	17	—21
B. Col. Elec. Prf.	67⅛	61¼	— 6	do. Pref. ..	49	25	—24
do. Preferred..	50	54½	+ 4½	do. 1st.. ..	70	52½	—27½

MANUFACTURING.

Babcock & Wilcox	3⅛	3 5/16	— 1/16	Elec. Construct...	1¼	1 3/16	— 1/16
Brit. Aluminium	1 15/16	1⅞	— 1/16	Gen. Electric ..	17⅛	2 1/16	+2 15/16
B. West. Pref. ..	2⅛	2 3/16	+ 1/16	Henleys	2 3/16	2 3/16	—
Callenders ..	10⅛	8¼	—2 1/16	India-Rubber ..	17	18¼	+1¼
Castner-Kellner..	3⅛	3 5/16	+ 1/16	Telegraph Con. ..	48	20⅛	+5*

*On undivided shares.

One of the features of the past few weeks has been an enormous outpouring of new issues. The electrical industry has taken its part, though a comparatively small one, in the demand for money. The general effect has been to reduce, a little, the quotations of the existing securities, and for obvious reasons. Newcomers must offer terms more tempting than those available from present stocks, and the diversion of public money into the former means that there is so much the less left for investment in the latter. The public have taken willingly, not to say greedily, the greater part of the new issues which have been so liberally presented, and that there is still plenty of money available for employment in stocks and shares is evident from the way in which company promoters are actively employed in the preparation of new prospectuses to be issued early in the New Year. The first year of peace has proved in some respects disappointing to those who looked for immediate resumption of normality, but the conviction that the anticipation of its fulfilment is only postponed for a while, lends sincerity to the hope that this may prove to all who are interested in electrical matters a Prosperous New Year.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Dec. 30, 1919.	Rise or fall.	Yield p.c.
Brompton Ordinary..	10	8	6⅞	+ ⅛	£6 16 2
Charing Cross Ordinary	4	4	2⅛	—	7 1 7
do. do. do 4½ Pref. ..	4½	4½	3	+ ½	8 3 8
Chelsea..	5	5	3	—	5 0 0
City of London	8	8	12	+ ⅛	6 13 4
do. do. 6 per cent. Pref. ..	6	6	8⅛	+ ⅛	6 8 0
County of London	7	7	9⅛	—	7 11 4
do do 6 per cent. Pref.	6	6	8⅛	—	6 9 9
Kensington Ordinary	7	6	4⅞	—	6 6 4
London Electric	Nil	Nil	1⅛	+ ⅛	
do. do. 6 per cent. Pref...	5	5	3⅝	+ ⅛	8 17 10
Metropolitan..	4	5	3	—	8 6 8
do. 4½ per cent. Pref. ..	4½	4½	3	—	7 10 0
St. James' and Pall Mall ..	9	10	6	—	8 6 8
South London	5	5	2½	—	7 8 6
South Metropolitan Pref... ..	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 6

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	90½	—	6 12 8
do. Def.	1½	83/8	22½	+ ½	7 10 0
Chile Telephone	8	8	6¼	—	6 8 1
Cuba Sub. Crd.	7	7	10½	—	*6 18 4
Eastern Extension	8	8	16⅝	—	*4 18 7
Eastern Tel. Ord.	8	8	168⅜	—	*4 15 0
Globe Tel. and T. Ord.	7	8	16⅜	—	*4 19 3
do. do. Pref.	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	22	23½	—	9 7 3
Indo-European	13	13	48⅝	—	6 13 4
Marconi	20	25	4⅝	+ 1/16	6 1 4
Oriental Telephone Ord.	15	10	2 1/16	—	4 14 1
United R. Plate Tel.	8	8	7⅝	—	*5 5 0
West India and Panama	1/8	1/8	1⅛	—	Nil
Western Telegraph..	8	8	17½	—	*4 12 9

HOME RAILS.

Central London Ord. Assented ..	4	4	82½	—	6 16 9
Metropolitan	1	1½	23½	+ 1½	4 18 0
do. District	Nil	Nil	21	+1	Nil
Underground Electric Ordinary..	Nil	Nil	2½	+ ⅛	Nil
do. do. "A" ..	Nil	Nil	6/6	+6d.	Nil
do. do. Income ..	4	5	87	+5	*5 15 0

FOREIGN TRAMS, &c.

Adelaide Sup. 6 per cent. Pref. ..	6	6	87	—	7 14 10
Anglo-Arg. Trams. First Pref. ..	£4	Nil	38	—	—
do. do. 2nd Pref. ..	—	—	3½	+ ½	—
do. do. 5 Deb. ..	5	5	61¼	—	8 2 8
Brazil Tractions	—	—	60⅛	—1	—
Bombay Electric Pref.	6	6	135	—	4 9 0
British Columbia Elec. Rly. Pfce.	5	5	61½	+2	8 2 8
do. do. Preferrred	Nil	2½	54½	+5	4 11 9
do. do. Deferred	Nil	Nil	52½	+1	Nil
do. do. Deb. ..	4½	4½	61	—	6 19 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42½	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	29	—1	Nil
Mexican Light Common	Nil	Nil	17⅛	—7/8	Nil
do. Pref.	Nil	Nil	25	—	Nil
do. 1st Bonds	Nil	Nil	52½	—2	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	8 5/16	+ 1/16	*4 14 2
British Aluminium Ord.	10	10	1⅞	—	5 14 3
British Insulated Ord.	25	12½	2	—	6 5 0
Callenders	25	25	8½	—	7 11 6
,, 6½ Pref.	5	6½	4½	—	6 11 6
Castner Kellner	25	20	3 7/16xd	—	3 15 7
Crompton Ord.	7	10	21/6	—6d.	9 6 0
Edison-Swan, "A"	—	10	1 5/16	— 1/16	8 8 0
do. do. 5 per cent. Deb. ..	4	5	81½	—	6 2 9
Electric Construction	10	10	1 1/16	— 1/16	9 8 2
Gen. Elec. Pref.	6	6½	19/6	—6d.	6 12 6
do. Ord.	10	10	40/-	—	*5 0 0
Henley	25	25	2½	—	5 11 1
do. 4½ Pref.	4½	4½	3⅝	—	6 4 2
India-Rubber	10	10	18⅛	— ¼	*5 9 7
Met.-Vickers Pref.	—	—	2½	—	5 14 0
Siemens Ord....	—	10	27/-	+1/-	*7 8 2
Telegraph Con.	20	20	26½	+ ½	*4 10 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, December 30th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£95	..
a Ammonia, Muriate (large crystal)	,,	£75	..
a Bisulphide of Carbon	,,	..	..
a Borax	,,	£39	..
a Copper Sulphate	,,	£41	..
a Potash, Chlorate	per lb.	1/1	..
a ,, Perchlorate	,,	1/3	..
a Shellac	per cwt.	£33	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers ..	,,	£28	..
a ,, Lump	,,	£15	..
a Soda, Chlorate	per lb.	6d.	..
a ,, Crystals	per ton	£70/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£88 to £299	..
c Brass (rolled metal 6" to 12" basis)	per lb.	1/3½	½d. inc.
c ,, Tubes (solid drawn)	,,	1/6½	..
c ,, Wire, basis	,,	1/3	..
c Copper Tubes (solid drawn) ..	,,	1/8½	..
g ,, Bars (best selected) ..	per ton	£157	£6 inc.
g ,, Sheet	,,	£157	£6 inc.
g ,, Rod	,,	£157	£8 inc.
d ,, (Electrolytic) Bars	,,	£128	£11 inc.
d ,, ,, Sheets	,,	£156	..
d ,, ,, Wire Rods ..	,,	£144	£11 inc.
d ,, ,, H.C. Wire	per lb.	1/5½	1½d. inc.
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/5	..
h Gutta-percha, fine	,,	10/- to 11/-	..
h India-rubber, Para fine	,,	2/6½	..
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
i ,, Wire, galv. No. 8, P.O. qual.	,,	£44	£2 inc.
g Lead, English Pig	,,	£46 10	£6 inc.
g Mercury	per bot.	£21	£1 dec.
e Mica (in original cases) small ..	per lb.	6d. to 4/6	..
e ,, ,, ,, medium	,,	5/- to 10/-	..
e ,, ,, ,, large ..	,,	12/6 to 25/- & up.	..
g Phosphor Bronze, plain castings	,,	1/6½ to 1/10	½d. to ld. inc.
g ,, ,, rolled bars & rods	,,	2/3 to 2/6	..
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	..
d Silicium Bronze Wire	per lb.	1/10½	1½d. inc.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	£310	£17 inc.
n ,, Wire, Nos. 1 to 18 ..	per lb.	4/6	3d. inc.
White Anti-friction Metals ..	per ton	£60 to £386	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

The Proper Position of an Engineer in Industrial and Political Circles.—In a paper read by Mr. E. C. de Segundo before the Woolwich Branch of the Society of Technical Engneers, on December 12th last, the lecturer said: Before considering the question of an engineer's position in industrial and political circles, it is necessary to define the term "engineer." There are many who usurp the title and it is, therefore, a difficult matter to distinguish between the false and the true. One American definition is that an engineer is "a man who can do for one dollar what any fool can do for two." At the first glance, an engineer would appear to be a man who works at a disadvantage to himself. In spite of this the description is an apt one, implying the possession of the ability to execute a task at the lowest expense in a minimum of time, and yet with the greatest efficiency. An engineer, then, must necessarily have energy, skill, and initiative. These attributes must have been developed by special education—he must therefore be a trained man. In addition to these mental and manual qualifications, however, an engineer must be a man of honesty and integrity, able to distinguish between questionable and true methods. Much of the present-day labour unrest is engendered by the lack of these virtues in both employers and employés—classes to either of which an engineer may belong. The former, in many cases, consider it their sole duty to get as much as possible out of their employés while paying them as little as they possibly can. On the other hand, employés often make it their ambition to obtain the highest possible rates, and at the same time to do a minimum of work. This is nothing short of civil war, and its effect upon the nation is disastrous, breeding mutual mistrust, discontent, and retarded production. The position of an engineer will depend entirely upon his qualifications, although, of course, there are bound to be a few exceptions. Nevertheless positions obtained by means of influence or favour cannot fail to work harm to the community if the occupants are not qualified to fill them. The position of a true engineer, therefore, is that of a leader carving out new paths of progress for the advancement of civilisation, bringing to bear the brains, the will, and the means of turning them to account.

THE HIGH-FREQUENCY RESISTANCE OF WIRES AND COILS.

By Prof. G. W. O. HOWE, D.Sc., M.I.E.E.

(*Abstract of paper read before the* WIRELESS SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS.)

THE last five years have seen a remarkable development of the application of high-frequency currents to telegraphy and telephony. In almost every such application coils through which high-frequency currents flow form an essential part of the apparatus. In some cases they contain an ounce or less of the finest wire, in others many hundredweights of massive copper strip or tubing. In all cases, however, it is a matter of importance to be able to calculate or, at least, to predict the losses occurring in these coils when carrying high-frequency currents. Without this knowledge it is impossible for the designer to utilise his material and space to the best advantage.

In this paper an explanation is given of the principles involved, and it is shown how these principles can be applied to the calculation of the resistance of wires and coils. A method of measuring the resistance is described and the results obtained are compared with the calculated values. The use of multiply insulated stranded wire is discussed. The paper is to be regarded as an opening contribution to a discussion on the subject.

Straight Conductors.—In a previous paper the author has shown how the well-known telephone transmission formulæ may be used to calculate the skin effect in many cases. It is there shown that in a solid round copper wire carrying a current of such a high frequency that the penetration is small, the ratio of the high-frequency resistance R_f to the steady current resistance R_o is given by the formula—

$$R_f/R_o = 0{\cdot}038\, d\sqrt{f} + 0{\cdot}25$$

where d is the diameter of the wire, and f the frequency.

For values of $d\sqrt{f}$ less than 32, or values of R_f/R_o less than 1·5, the penetration into the wire is so great that the assumptions made in establishing the formula are no longer tenable. Even in this case, however, the problem can be solved by applying the graphical method so frequently employed in studying telephonic transmission problems. The line is divided into a number of sections by assuming its leakage and capacity to be concentrated at a number of equidistant points. The current and potential difference at the receiving end are assumed and those at any point of the line determined by constructing a vector diagram section by section, commencing at the receiving end and gradually working back along the line. This method was applied to the determination of skin effect in the paper already referred to.

The vector diagram is instructive in showing how the magnitude and phase of the current vary with increasing depth. This is shown in fig. 1 for $d\sqrt{f} = 79$. It is seen that at the moment of maximum current the central portion of the wire is carrying current in the reverse direction.

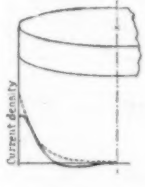


FIG. 1.

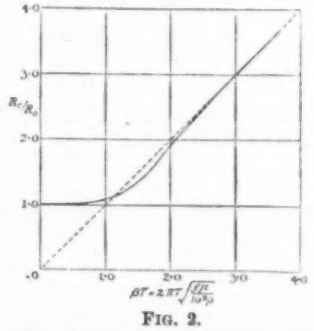


FIG. 2.

FIG. 1.—CURVES SHOWING MAXIMUM VALUE (DOTTED) AND VALUE AT MOMENT OF MAXIMUM TOTAL CURRENT (FULL LINE).

When it is desired to keep the inductance of a circuit as low as possible, parallel strips placed close together are frequently employed. The current is concentrated towards the inner faces. If the frequency is so high that the current density at the back of the strips is practically zero, this is the simplest of all skin-effect calculations. The resistance and losses are the same as if the total current were distributed uniformly over a layer of depth t where—

$$t = \tfrac{1}{2}\pi\sqrt{10^9\rho/f\mu}.$$

For copper the permeability $\mu = 1$, and the specific resistance $\rho = 1{\cdot}7 \times 10^{-6}$ ohm per cm. cube, at a frequency of a million, $t = 0{\cdot}066$ mm. If the frequency and the thickness of the strips are such that the current penetrates appreciably throughout the whole cross-section—

$R_f/R_o = \beta\tau/\gamma$, where $\beta = 2\pi\sqrt{f\mu/10^9\rho}$, τ = the thickness of the strip, and $\gamma = (\cosh 2\beta\tau - \cos 2\beta\tau)/(\sinh 2\beta\tau + \sin 2\beta\tau)$.

For small values of $2\beta\tau$, that is, for low frequencies or very thin strips, this reduces to—

$$R_f/R_o = 1 + 2/3\,(2\beta\tau)^4/5!$$

which for copper may be written

$$R_f/R_o = 1 + 47{\cdot}5\,(\tau\sqrt{f})^4\,10^{-6}.$$

The value of R_f/R_o for any value of $\beta\tau$ can be read directly off the curve in fig. 2.

When the frequency is such that the current is confined to the outer skin of a round conductor, material can be saved by using a tube. If the thickness of the wall is such that the current density at the inner surface is negligible, the resistance will be the same as if the conductor were solid; if, however, the wall is so thin that the current density is appreciable throughout, the above formula for the strips can be applied. τ is then the radial thickness of the wall, which should not exceed one-third of the radius.

Single-layer Cylindrical Coils.— In the previous paper the author has shown that the resistance of a long coil closely wound with a single layer of square or rectangular wire is given accurately by the same formula as that already found for the parallel strips, viz.:—

$$R_c = R_o\,\beta\tau/\gamma$$

where τ is the radial thickness of the wire. The values of R_c/R_o are plotted in fig. 2 against values of $\beta\tau$.

If the wire has a square section of side τ cm. and if s is the number of turns per cm., $s\tau$ is the fraction of the axial length occupied by the conductor, the remainder being occupied by insulation or air space. The penetration would be the same if the turns were close together, but the permeability of the material reduced from 1 to $s\tau$. Assuming the conductor to have unit permeability, β would be reduced to—

$$2\pi\sqrt{s\tau f/10^9\rho}.$$

It will be seen from fig. 2 that the values of the ratio R_c/R_o are practically independent of $\beta\tau$ for values of the latter up to 0·6, but directly proportional to $\beta\tau$ if it exceeds 2·5. Hence, when the frequency is so low that the skin effect is only slight, the pitch of the turns has little effect, but at very high frequencies where the skin effect is very pronounced, the ratio R_c/R_o is proportional to $\sqrt{(s\tau)}$. This is only strictly true when $s\tau$ differs but little from unity.

For many purposes it is convenient to consider the ratio of the high-frequency resistance R_c of the coil to the high-frequency resistance R_f of the same wire when straight.

A round wire equal in diameter to the side of a square wire has $4/\pi$ times its resistance both at very low and at very high frequencies. It may be assumed, therefore, as an approximation, that this ratio is constant at all frequencies. The inscribed-circle method gives results in good agreement with observations: the biggest difference between the calculated and observed results is about 4 per cent. for values of $\tau\sqrt{f}$ ranging from 0 to 42.

The values of R_c/R_o and R_c/R_f have been calculated for a solenoid of square wire with $s\tau = 1{\cdot}0$, 0·8, 0·5, and 0·25 respectively.

TABLE I (*Abridged*).

Calculated Values of R_c/R_f for Coils Wound with Square Wire.

$\tau\sqrt{f}$.	R_f/R_o.	$s\tau = 1$. R_c/R_f.	$s\tau = 0{\cdot}8$. R_c/R_f.	$s\tau = 0{\cdot}5$. R_c/R_f.
2	1	1	1	1
4	1	1·012	1·006	1
6	1·001	1·06	1·039	1·015
8	1·003	1·175	1·115	1·035
10	1·007	1·38	1·26	1·1
12	1·015	1·667	1·47	1·2
14	1·027	2·006	1·735	1·335
16	1·045	2·3	2·01	1·5
18	1·071	2·54	2·24	1·69
20	1·104	2·745	2·44	1·885
24	1·200	3·033	2·72	2·125
30	1·399	3·26	2·92	2·31
40	1·774	3·43	3·06	2·43
60	2·569	3·56	3·18	2·52
120	4·888	3·74	3·34	2·64
200	7·98	3·81	3·41	2·69

The results are given in Table I (abridged). It has been assumed that the coils are long and that the diameter is large compared with the pitch.

If the author's formula for square wires is assumed to hold approximately for round wires of equal cross-section, we have—

$$R_c/R_o = 1 + 23 \times 10^{-6}\,(d\sqrt{f})^4\,(s\,d)^2,$$

in exact agreement with Wien and Sommerfeld. This formula is only applicable to low frequencies ($d\sqrt{f}$ less than 10).

None of these formulæ take into account the effect of the diameter of the coil, which may be an important factor for small values of $s\,d$; the formulæ assume the coils to be very long in comparison with their diameters, and they would obviously be very inaccurate if applied to narrow coils of large diameter.

A number of measurements of the high-frequency resistance of coils have been made at the Imperial College of Science and Technology during the last three or four years by the author and by several research students, especially Mr. Smith-Rose, B.Sc., and Mr. W. Greenwood, B.Sc.

In the case of a coil of 92 turns of 0·264 cm. wire, the total length of the coil being 26·9 cm. and its external diameter 2·86 cm., the calculated values for the equivalent square wire are about 11 per cent. greater than the measured values of R_c/R_o. Another coil consisted of 62 turns of wire 0·163 cm. diameter with a total length of 20·4 cm. and a pitch of 0·33 cm. The calculated values of R_c/R_o are 26 per cent. higher than the measured values.

Exigencies of space sometimes compel the designer of radio apparatus to employ coils with more than a single layer of wire. The inductance increases as the square of the number of turns in a given length, whereas the resistance to steady currents is directly proportional to the turns. At high frequencies, however, the resistance may be greatly increased by the addition of a second or third layer.

If the size of wire and the frequency are such that the skin effect is very pronounced, the effective resistance increases much more rapidly than the inductance as the number of layers is increased. When, however, the penetration into the wires is considerable, the calculation of the effective resistance is much more complicated.

TABLE II.—VALUES OF R_c/R_o.

$\beta\tau$.	First layer.	Second layer.	Two-layer coil.	Third layer.	Three-layer coil.
0·5	1·000	1·05	1·02	1·13	1·06
1·0	1·086	1·73	1·41	3·01	1·94
1·5	1·376	4·17	2·77	9·76	5·10
2·0	1·897	8·36	5·13	21·25	10·50
2·5	2·475	12·70	7·59	33·15	16·11
3·0	2·988	16·08	9·53	42·12	20·40

Table II gives the values of R_c/R_o for coils with various numbers of layers. These values refer to long coils closely wound with square or rectangular wire, and corrections must be applied for the spaces between adjacent turns, and for the coil not being very long compared with its diameter. The results are not affected, however, by the space between adjacent layers. With round wire an approximate result can be obtained by assuming it to be replaced by square wire of equal sectional area.

It is a common practice to make wires intended for high-frequency currents of a large number of small wires, each separately insulated, and the whole so stranded that every individual wire occupies in turn the same relative position in the composite wire. In this way the current is forced to distribute itself uniformly between the individual wires. It must not be assumed, however, that because these wires are of so small a diameter that when used alone they exhibit but little skin effect, the composite wire will, therefore, have the same resistance to high-frequency currents as to direct currents. The author discussed this subject in detail in a paper read before the Royal Society in 1917. The ratios R_c/R_o and R_f/R_o are in many cases so great, that better results would be obtained by using a solid wire even of the same copper section. The solid wire can, however, have a much larger cross-section of copper and still occupy the same space in a coil. Not only is the solid wire much cheaper, but the making of end connections and tappings does not introduce the difficulties met with in dealing with stranded conductors. In many cases in which the stranded wire has a theoretical advantage, this is so small as to make it doubtful whether the use of stranded wire, with its attendant disadvantages, is justified. The cause of the high effective resistance of the stranded wire is the eddy-current loss in the individual wires, due to the magnetic field produced by all the other wires.

Another interesting fact which was shown in the paper referred to was that the minimum high-frequency resistance was not obtained by putting as many individual wires as possible into the available space, but that there is an optimum space-factor beyond which the addition of more wires increases the resistance.

TABLE III.—CORRECTION FACTORS FOR SHORT COILS.

l/D.	B'/B.	$\sqrt{(B'/B)}$
0·25	0·61	0·78
0·5	0·70	0·84
1·0	0·82	0·91
2·0	0·92	0·96
4·0	0·97	0·985

The calculated formulæ for the high-frequency resistance of coils are all based on the assumption that the coils are very long in comparison with the diameter. In a short coil the density of the magnetic flux at the inner side of the wire is less than in a long coil with the same number of ampere-turns per centimetre. The value of R_c/R_f for a short coil can be read off the curve for a closely-wound infinitely long coil if instead of $\beta\tau$ one takes the value—

$$\beta\tau\sqrt{(8\tau)}\sqrt{(B'/B)}$$

where B is the flux density in a long solenoid and B' that in the short coil, the values being determined at the inner side of the wire. The author has calculated the ratio B'/B for various values of l/D and the results are shown in Table III.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

WESTERN CENTRE.

AT Bristol, on December 1st, Mr. W. A. Chamen addressed the Western Centre on the financial side of electricity supply. He said: All engineers must be profoundly sorry that considerations of finance have to enter into any of the wonderful schemes, not to mention castles in the air, which emanate from the deep recesses of their minds from time to time. And yet, without the necessity for considering the financial side of any scheme, our usefulness would be largely, if not entirely, gone, and the need for our services would probably almost entirely disappear. For it is economy in the expenditure of money, both in the first cost of the schemes which are propounded and in the maintenance of them, which governs the whole matter. What is the use of them all, unless they serve some purpose of economy? People sometimes talk about "private" money and "public" money and "Government" money, but, after all, there is nowhere for the money to come from except, in some way or other, from individuals. If the Government finds money it issues a loan on the security of its power to tax the people, *i.e.*, the individual. The money itself comes from the public in one way or another; in the first instance from the pockets of individuals. And so it must surely follow that in seeking money for the carrying out of any scheme, the scheme must be propounded and explained in such a way as to tempt the individual to put his money into it. This root fact is exactly the same, no matter by whom an undertaking is run. In all these alternatives, the money comes from the same source, and the individual is really responsible for deciding as to what enterprise he will place his money in. Now there is a difference between Government or municipal concerns and company concerns. In the case of a Government or municipality, money is borrowed from individuals. It is secured by being made a charge upon the taxes of the country or the rates of the municipality or other local authority as the case may be. If the concern does not prove a financial success, the deficit is made up by increasing the taxation or the rating, as the case may be, of the people, that is, of the individual. For this reason, the rate of interest on money lent to a Government or municipality is low. There is no risk directly attaching to the loan of money by the individual. But with a company the case is different; the element of enterprise enters in. The individual lends his money in the hope of receiving a dividend. He has no security like the investor in Government or municipal stocks, but is willing to risk his money in the hope of getting a higher rate of interest. It is not difficult to see, therefore, that unless there is a possibility of a shareholder in a company getting a larger rate of interest than he can do from Government or municipal investment, not a penny piece will be invested in companies. Possibly this fact is seized upon sometimes to argue that all schemes ought to be carried out by means of loans issued by Government or municipalities, so as to borrow money at a low rate of interest and prevent the temptation to what, in these days, may be called profiteering, by taking higher rates of interest when they can be got, and thus raising the price of electricity above what it need be. This line of argument, however, loses sight of some facts which have a most important bearing on the question. One of these is that the Government or municipality has to repay the loan and, consequently, the price charged for electricity must be sufficient to cover annual payments into a sinking fund, of such an amount as shall accumulate the total amount of capital to be repaid by the time the term of years for which the loan was granted has expired; while, on the other hand, there is no obligation on a company to put by a sinking fund for repayment of capital subscribed for ordinary shares, or even for preference shares. Again, there is no obligation on the part of a company to increase the price of electricity to such a figure as will ensure payment of a certain dividend on the shares of the company if for a period the development of the undertaking does not allow of a dividend being earned when reasonable prices are charged for the energy supplied. The shareholder knows this full well, and often makes his investment knowing that for some years he will get no dividend, but he believes that he will get a dividend in the end as will recoup him for the lean years. This fact stimulates the rate of development by company enterprise, because good dividends can only be earned when the concern reaches a stage of considerable development and, assuming that prices realisable for the sale of electricity are sufficient to provide a reasonable margin when the concern is more or less fully developed, the capitalist is willing to risk money, although for the time being no dividend can be paid. It not infrequently happens that all the capital subscribed for ordinary shares is spent before a stage of development is reached sufficient to pay any dividend. If this continues, people do not care to continue subscribing money, but are willing to do

so upon an issue of preference shares. Beyond this, it is sometimes necessary for the concern to borrow money specially at fixed rates of interest, on debentures or debenture stock, the interest on which *must* be paid year by year; otherwise the holders may appoint a receiver. There is, therefore, a considerable risk in proceeding by means of company enterprise, which obviously must be compensated for by the prospect of reasonably good dividends. There are, however, no electricity undertakings run by companies which are free to make whatever profit they may like. All of them are limited in some way or another, and the public is always protected by a limitation of price in the Act or Provisional Order under which the concern is worked; so that there is but small chance of profiteering at the public expense in the electricity supply industry. It may be that there are advantages in some ways in the Government or municipal method of procedure, but on the whole, the advantage, even from the public point of view, lies with a properly guarded and properly managed company undertaking. If such a limitation were imposed upon the rate of dividend or interest which a company might pay, as to reduce it to the level of a Government or municipal loan, no money would be found for any company enterprise, and it is difficult to see how it could be found for Government or municipal enterprise either, for a very large number of individuals are not satisfied to lend their money at very low rates of interest, in spite of the absolute security of rates and taxes, and there would come a time when, in order to get money, the rate of interest would have to go up. It is surely wiser to allow reasonable and proper freedom for the earning of interest on capital employed in public utility undertakings, and so encourage the finding of capital, than it is to hamper it by limitations which take away all the spirit of enterprise and hamper energetic development. It is remarkable that the Electricity Bill does nothing to encourage the idea that Government will readily find money for the development of electricity supply, though it provides for that being done more or less as a last resort. Elaborate provisions are set out for the financing of District Boards, if such boards are formed, but they all seem to do away with the element of enterprise, and take the form of powers, granted to the District Boards and to the Electricity Commissioners, to borrow money by the issue of stock bearing interest at some fixed rate, and redeemable at such time as the Electricity Commissioners may decide. It would seem very doubtful if individuals will be willing to invest their money in this way unless the rate of interest is considerably higher than it has been on municipal or Government loans hitherto. And this interest as well as the repayment of the loan must all come out of the consumer, *i.e.*, the price charged for electricity must be sufficient to cover all these charges. The prospect of getting a cheap supply of electricity under a District Board does not seem very promising, but the Bill as amended and now passed by the House of Commons does not make the formation of District Boards compulsory. Under clause 5 (2) associations or bodies within the district are given an opportunity to submit schemes for improving the existing organisation, if it needs improvement, in the views of the commissioners. It may not be easy to suggest, in detail, how this can be done, but the first thing to do is to create the desire for such a scheme, and, having done that it is wonderful how difficulties seem to dissolve. The desire must be unanimous; it may be that some degree of self sacrifice will be required, but do not let us allow what may be an entirely imaginary bugbear to hinder us from putting our heads together with the real desire to improve the whole existing organisation of electricity supply. The problem *might* possibly be dealt with by the giving and taking of bulk supplies between the parties, but that would probably entail keeping up certain walls of separation between them, and it would probably be far better to amalgamate the different concerns. This involves the difficult question of finding a way to unite the different orders of capital, municipal and company. There cannot, however, be any insuperable difficulty about this matter, and it must be remembered that the alternative is the District Board with its purchase of all power stations and its practically unavoidable waste of money both in first cost and in maintenance. If taken advantage of in this way the Electricity (Supply) Bill opens up an avenue of progress such as has not been possible before, but if we allow the formation of District Boards, as alternatively provided for, we shall be taking a retrograde step, and causing at once a strong feeling of want of confidence among those who have their own generating plant. They will be afraid to place themselves in the hands of District Boards on the score of economy. Human nature cannot be reformed by coercion. We must look to something quite different from District Boards to bring about that unity of aim and interest which alone can give us prosperity and peace.

DISCUSSION AT BRISTOL.

Mr. H. FARADAY PROCTOR said he was particularly interested in the address because he did not see eye to eye with the author. He advocated a District Board for his locality. The interest which the Government or a local authority paid was less than that which companies paid because they could get money at that cheap rate. Was not the fact that the money was cheap sufficient evidence that the supply was sufficient? Plenty of money could be got at that comparatively cheap rate of interest provided the security was good. He did not understand the protests against what was considered to be the elaborate system proposed in the Bill for the financing of District Boards. There were two sums of money mentioned, 20 millions and 25 millions. Neither of these sums was intended for the systematic financing of District Boards. The financing of the District Boards would be done by the various component parts of those Boards guaranteeing the sums required. Money would be raised only by the issue of stock—the Boards were empowered to issue stock, and such must be guaranteed, to give the investor that security which would ensure his capital being forthcoming when necessary. Some areas might be so sparsely populated as not to be able to provide a sufficient guarantee for a large scheme which it might be desirable to inaugurate, in which case the 25 millions which the Commissioners were to have placed at their disposal would come into use. They would lend some of that money to the District Board.

The joint electricity authority had to be representative of authorised undertakers within the district *either with or without* the additional representatives of any county, other local authorities (not being authorised undertakers), large consumers, and other interests. A District Board should incorporate the local authorities, companies and persons who were authorised undertakers, but it should also include the representatives of railway companies who used or proposed to use electricity for traction purposes, of large consumers, and of labour, and where there were other local authorities and County Councils not being authorised undertakers, who provided financial assistance, they also got representation. What reason was there for the suggestion that the incorporation of these other people—the consumers, for they had to come into the District Board—would lead to extravagance? As regards the incorporation of other local authorities, who were not at the moment authorised undertakers, why should they be tempted to extravagance? It was not compulsory to have labour represented on the joint electricity authorities; on the District Board it was compulsory. His experience with labour had not been so very bad when one got in close contact with labour as a rule; there were exceptions, there was nothing bad or unreasonable. At any rate let them see behind the scenes. Referring to the objection that all the money for the repayment of interest and dividends had to come out of the consumers' pockets, it was a very poor company that did not take its dividends out of the consumers' pockets. Surely, the representation of the large consumers, who were the persons most keenly interested in the production of cheap electricity, was the very best form of representation one could have on District Boards.

Mr. J. H. EDWARDS thought that finance was the chief thing to consider in connection with electric supply, but finance went a little further than actual money. For instance, they had to consider the saving in coal as much as the saving in money. He suggested that in this proposal of the Government they were aiming at conserving the coal resources of the country, and that the Government had at last realised that the vital thing for the life of this country was electricity supply. It was hoped by giving a cheap supply of electricity to proceed a good distance towards the solution of the housing problem. If they were ever to have peace between the capital classes and the workers they must attempt to solve the problem of the slums. He was not a believer in nationalisation, but he suggested that none would think to-day of handing over the water supplies of this country to private enterprise. In connection with the Electricity Bill how far were they to go? Was it a reasonable suggestion that the actual generation of electricity and the provision of trunk mains could be efficiently nationalised, whereas the more intricate section of the work required a more elaborate scheme of organisation, that was best left to private enterprise?

Mr. W. HARDY was interested in the Electricity Bill from the consumers' point of view, and did not know whether under the Government scheme they were, as consumers, going to benefit in the price of electricity supply. At the same time a scheme which unified electricity supply should in itself supply the consumer at a cheaper rate, provided, of course, the cost of transmission did not overcome the cost of production by the consumer himself. He understood the scheme had not been formulated from a financial point of view, but purely to give a cheap supply to the country. He had always felt that they, as electrical engineers, did not produce the best value from coal, and it seemed that a scheme of that size was being run into very quickly without due consideration of that fact. An endeavour should be made to use the heat of exhaust steam; that heat should be used for heating for domestic and industrial purposes, and for that reason an electricity scheme with a tremendous distributing area would not be the right thing.

Mr. H. H. THOMPSON said that one must congratulate Mr. Chamen on the splendid imagination shown in the latter part of his address; if he was serious in his main conclusions, however, one was inclined to agree entirely with Mr. Proctor. Personally, he believed in the present and its possibilities, especially as new conditions, commercial and financial, and extremely interesting possibilities had arisen out of the war. The appeals to the public in connection with new issues at low rates of interest was evidence that a large section of the

community was generally satisfied with small returns on money invested consistent with small risk. As to the financial success of electricity supply under the proposed conditions, he was optimistic; it was not always sound to estimate future success by past results. Now the state of things was quite different; electricity supply had become a prime necessity of industrial growth and economic life. If the new loans for the proposed developments were raised by private subscription, that would be a good feature. Direct public interest in the new schemes as proposed should tend towards closer scrutiny and consequent reduced expenditure. He was scarcely in agreement with the feared effects of Government control, or the bad effects of what was termed nationalisation. State management by expert business-like officials had still to be tried and tested.

Mr. A. L. STANTON doubted "the belief" in *cheap* electric power supply, as expressed through the medium of the daily Press. He disagreed with the view generally held which asserted the Bill to be mainly based upon a desire to conserve the national coal supplies. It was yet to be laid down that coal exports would definitely cease; steam raising coals such as were at present used by generating stations represented but a fraction of the total grades of coal annually produced; by the time the national coal resources reached the limit line, the scientific developments of that age would have far superior methods in operation to those now employed; finally, the war was largely won as a result of the part played by engineering and allied production on a scale hitherto undreamt of. How was the result achieved? Largely as a result of the enormous flexibility and other advantages which electricity supply as already available presented in the shape of an industrial power utility. The prosperity of the country depended upon its industrial expansion which implied a capability to produce commercially with economy, rapidity and continuity of output. The Electricity (Supply) Bill represented a recognition of the part played by this form of energy during the war, and aimed to utilise it to a far greater extent as an element of the highest importance during peace. Resting upon such foundations and realising the all-importance of the "financial aspect" as an element of success, one could not doubt but that the necessary capital required for promoting essential schemes would surely be produced. Granted that Government control of utilities had proved itself inefficient and wasteful in the past, he could not see that such judgment constituted any justification for allowing matters to remain so. They had the power to raise the standard and should use it. He was in accord with Mr. Proctor's references to "the labour element." His experience was that the surest way to obtain progressive effort from the so-called "labour element" was to prove by one's individual actions that its place in the universe was recognised, and that no monopoly of intelligence existed anywhere. Respect was thus gained and confidence was held.

Mr. W. A. CHAMEN, in reply, said that his objection was that a District Board had got to purchase or acquire generating stations. The scheme which he favoured was the joint electricity undertaking. That there was no hardship in waiting for dividends so long as the burden of the loss fell upon the community which benefited, he was in absolute agreement. The water supplying London was now excellent, but the cost of it had gone up so much that the Board had had to apply for powers to increase the charges; the statutory local authority had to make up deficits out of the rates. One might get an excellent engineering proposal, but it might not be an economic one; that was the lesson to be learnt from the London Water Board. The utilisation of exhaust steam was provided for under the Bill. It seemed to him more satisfactory to arrange that in conjunction with a unified scheme, in which the big consumers took their part, but they had to negotiate with District Boards. Power companies had a lot of "water" in their capital; there were, however, two ways of looking at that. Contractors were enterprising; they wanted to stimulate a demand for their production, and they thought that power companies could be of assistance in that direction. The idea was good, and there was a spirit of enterprise in what they did, and they owed a debt to the contractor that power companies had gone so far as they had. They had suffered very severely from lawyers' government. He did not agree that human nature was unalterable.

INDUSTRIAL ELECTRIC HEATING.

CONSIDERABLE attention has recently been directed to the application of electric heating for industrial and commercial purposes, and some notable developments have taken place in Switzerland in this direction, where, according to an article in *Le Génie Civil*, of August 30th, 1919, by F. Rutgers, electrical energy is being largely utilised for heating in laundries, textile mills, and foundries, as well as for central heating systems in offices, workrooms, &c., with a marked economy over the use of coal or coke.

The special conditions obtaining in Switzerland with its abundant water power, and consequent cheap supply of energy, have in no small measure contributed to the results obtained. Nevertheless, even in countries not so favourably circumstanced it should not be impossible for electric heating

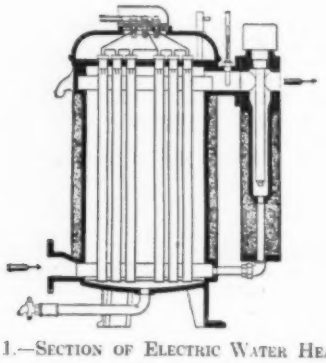
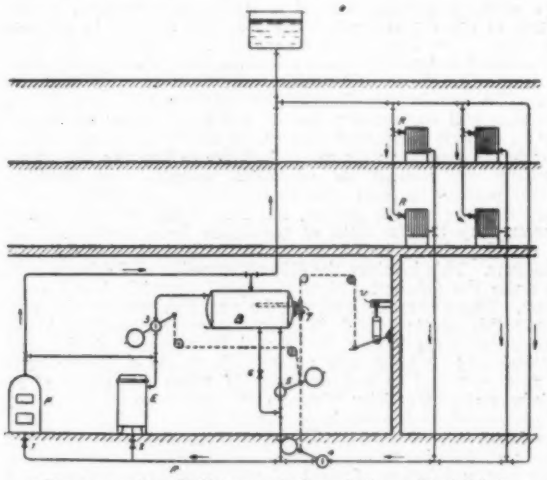


FIG. 1.—SECTION OF ELECTRIC WATER HEATER.

to find far more extensive application in the industries in competition with the existing methods than is at present the case, more especially when the manifold advantages of this form of heating are properly realised. The heat required can be produced exactly at the time and place desired, it can be efficiently and simply controlled, and when the heating appliance is out of service losses can be reduced to a minimum. In many cases the heating can be performed entirely at night, when it should be possible for energy to be supplied at a specially low rate for this purpose, considering the ideal nature of such a load, and its importance in materially raising the load factor of the supply station. Moreover, the economy of electric heating does not solely depend upon the relative cost of coal and electricity as is so often supposed.

One kilogramme of coal yields 7,000 calories, and 1 KW.-hour gives 860 calories. Theoretically, it would thus be necessary to replace 1 kg. of coal by 8 units of electrical energy; but in reality this is not so. Results obtained in practice show that owing to higher efficiency and use under favourable conditions, rarely more than 5 units are required to replace 1 kg. of coal; more often this figure does not exceed 3 to 4 units.



B, Storage vessel; R, Radiators; F, Ordinary boiler; E, Electric boiler; T, Thermostat; U, Retarder.

FIG. 2.—DIAGRAM OF CENTRAL ELECTRIC HEATING SYSTEM WITH DELAYED DISTRIBUTION.

The special electric heating apparatus described and illustrated in the article referred to above are manufactured by the Swiss Oerlikon Works, and cover a variety of types for heating water, generating steam, producing hot air, &c.

The type of heater generally used for hot water is the tubular circulating boiler depicted in fig. 1. The one illustrated is for 100 KW., has a height of 1.5 m. (4.92 ft.), and a diameter of about 0.5 m. (19.7 in.). These boilers are also made for a capacity up to 300 KW. For still higher powers several boilers are used. The tubes enclose the electric heating elements and are mounted on a special base, and they

can be readily removed for cleaning and scraping. When automatic control of the temperature is required a thermostat can be fitted to interrupt the supply current when a predetermined temperature is exceeded. For small installations, provision can also be made for automatically closing the circuit as soon as the temperature falls below a certain value.

The boilers of this system are mainly used for heating water in breweries, dye-works, chemical works, hotels, &c. In conjunction with a tank they can also be used for hot-water storage, and are frequently employed in central heating systems in factories, dwellings, offices, &c. Fig. 2 shows an electric boiler operating in parallel with a coke-fired boiler for central heating.

A central heating system which has given special proof of its value is one in which the electric boiler and storage vessel are heated during the first part of the night, *i.e.*, up to about 4 o'clock in the morning, when the cost of the electrical energy is low. As soon as the storage vessel reaches the maximum admissible temperature the hot water is automatically caused to circulate through the heating system, and the rooms are heated. During the day the supply of heat is derived from the heat accumulated in the storage vessel. When the weather is cold, the necessary heating during the day can be obtained either by means of an electric boiler of small power or by burning wood or turf in the existing boiler. This central electric heating system with delayed heat distribution has the advantage that smaller storage vessels can be employed than would otherwise be neecssary for the thermal storage obtained by utilising the whole energy available during the night. The rooms are heated before work is started; no attendance is required during the night; the circulation is automatically effected. In fig. 3 is shown a diagrammatic representation of this central heating with "delayed heat distribution."

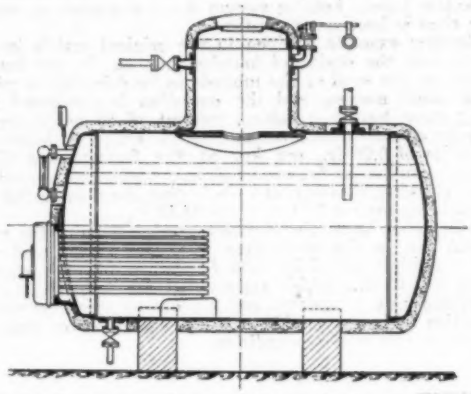


Fig. 3.—Section of Electric Steam Boiler for 500 kw.

Very often the tubular radiators, or immersed radiators as they are termed, are placed directly inside the thermal storage tanks, and are also used in a similar manner inside vats in breweries, inside coppers in laundries, &c.

For the generation of steam electrically similar radiators, but of larger capacity and heavier construction, are used, and the arrangement employed is that shown in fig. 3, which is a sectional elevation of a 500-kw. electric steam boiler.

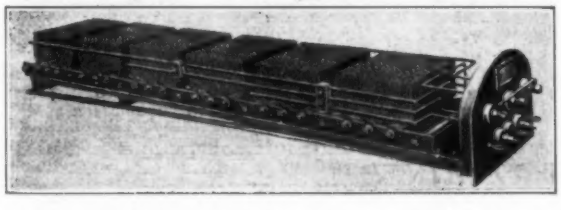


Fig. 4.—Removable Grate Radiator for Coal-Fired Boilers.

These electric boilers can be installed direct in workshops without fear of trouble, provided they are of sufficiently robust construction, as the current can be instantly shut off, and the production of steam stopped momentarily, which is impossible with coal-fired boilers. In Switzerland the authorities stipulate that the boiler must be built for a pressure equal to 1½ times the normal working pressure. As an example, if the working pressure is 88.2 lb. per sq. in. (6 atmospheres) according to these rules it must be designed for a working pressure of 132.3 lb. per sq. in. (9 atmospheres) and a test pressure of 205.8 lb. per sq. in. (14 atmospheres). It is a simple matter to provide for the automatic interruption of the supply when the pressure rises above a certain value or when the water level drops.

Electric steam boilers have a large field of application in chemical factories, textile mills, dye-works, chocolate factories, &c. Specially good results have been obtained with them in installations in which in the summer steam is only required in small amounts for certain purposes, when the ordinary steam boiler would be working under uneconomical conditions.

An interesting application of the electric steam boiler is made in a spinning mill in which it is used in combination with an ordinary boiler. In the mill a large quantity of energy is available during the night, which is utilised in the electric boiler for heating the main boiler, which in this way acts as a heat accumulator. At times of heavy load the steam produced can be used directly by means of automatic reducing valves and an overflow valve. The electric boiler used takes 500 kw., and generates steam at a pressure of 117.6 lb. per sq. in. (8 atmospheres).

Another special application of electric heating is the use of removable radiators (fig. 4), which are placed on the grate of an ordinary steam boiler to keep it under pressure during the night.

The production of hot air electrically is also of growing importance. The air, is blown upon the radiator by means of a fan. For small powers in drying installations spiral radiators are employed. For larger powers the radiators are built up of special cast resistances such as those shown in fig. 4. The temperature of the radiator is from 400 deg. C. to 500 deg. C. They are employed for heating houses, in drying plants, &c. A portable type for 300 kw. is illustrated in fig. 5.

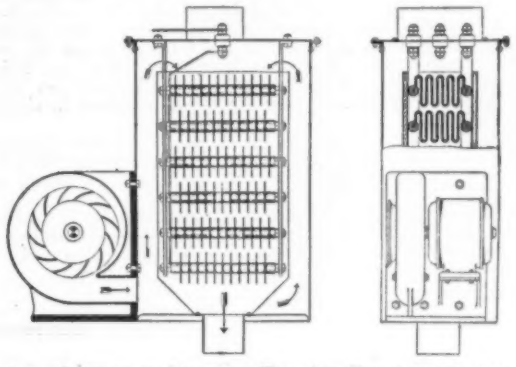


Fig. 5.—Section of Electric Hot Air Furnace for 300 kw.

These electric hot-air furnaces are very extensively employed in foundries, where they are displacing the small portable coke furnaces hitherto in vogue for heating moulds. The numerous disadvantages of coke furnaces, such as the vitiation of the air of the foundry, frequent attendance, liability to burn, dirty moulds through flying cinders, &c., disappear with the hot air electric furnace.

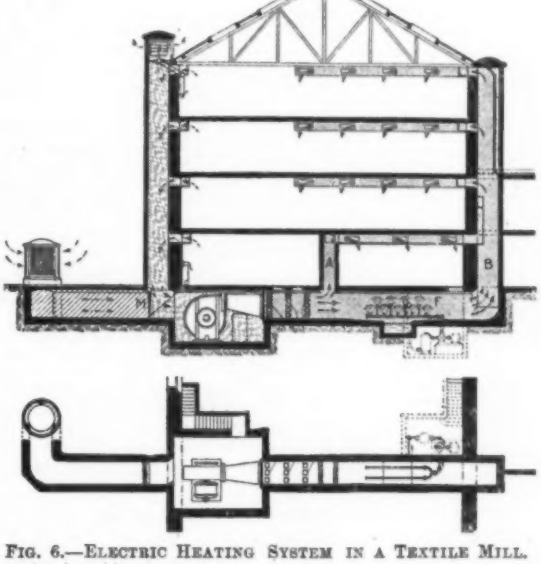


Fig. 6.—Electric Heating System in a Textile Mill.

In most of the Swiss foundries these electric furnaces are used in place of coke furnaces, and the moulds are dried during the night. In many foundries even stationary electric furnaces are used, and the cores and small moulds are then

dried inside them. The cold air is first heated by being passed through a double spiral; heat losses are thus minimized.

For localised heating in machines the electric heating system is specially advantageous, and either the spiral type of radiator is used or a radiator similar to those already described made up of special resistances in various shapes. The simplicity of regulation and the desired localisation of the heat required make it superior to all other methods.

In addition to the central electric heating system with water, steam, or hot air, radiators with or without heat storage can be used for heating rooms, &c.

An interesting innovation in connection with heating rooms consists in arranging simple tubes analogous to those used with low-pressure steam systems around the walls. The electric heating elements are contained in these pipes, and a large development of heat is obtained with a low energy consumption. This arrangement is of special use in textile mills, more particularly in carding rooms, owing to the reduced superficial temperature of the pipes. Fig. 6 shows an electric heating and ventilating installation in a spinning mill combined with a plant for humidifying the air.

The energy required for various heating purposes can in many cases be simply calculated when, for example, the quantity of water or air to be heated and the temperature are given. The energy necessary to produce a determinate amount of steam is known, and the heat losses can be kept within well-defined limits by appropriate heat insulating means. Also the quantity of coal previously used can serve as a basis for comparison with the results obtained in similar installations.

From 4 to 5 units replace 1 kg. of coal in the case of central heating. With drying furnaces for foundries the ratio is 4.5 to 1, and in certain manufacturing methods 2 KW.-hours are used, as compared with 1 kg. of coal.

In connection with heat storage, good results have been achieved with thermal storage by water or steam extending over several decades. Thermal storage by means of electrically heated stone slabs has also been realised.

As regards the electrical pressure of electric heating apparatus for small portable heaters voltages above 250 volts should not be employed. In the case of large installations 500 volts has given good results. Higher pressures are not to be recommended owing to the possibility of danger in handling. For steam generation electrically in addition to the electric tubular type of boiler, electrode apparatus are used which can be easily designed for several thousand volts. Pressures exceeding 5,000 volts are, however, but little suitable. At present the best solution is the tubular type of steam boiler for a maximum pressure of 500 volts.

As an example of the economy to be obtained in certain cases by using electricity instead of steam for heating a wool mill may be cited, in which 400 kg. of coal were consumed daily for the exclusive heating of the dressing machines in the summer. With electric heating only 575 units were required per day, showing a considerable saving, as theoretically about 2,400 units correspond to 400 kg. of coal. The equipment of the mill which was carried out by the Oerlikon Works, comprises, in addition, an electric steam boiler and an electric hot-air heating system for the winter, as well as other electric heating apparatus.

A further example is given in the original article in connection with the drying of foundry moulds. In the foundry in question the sand of the mounds to be dried has a volume of 2.5 cubic metres, and the operation is conducted in a drying room having a cubical content of 25 cubic metres. The coke consumption amounted to 280 kg. in 12 hours, and at a price of 0.24 fr. per kg. at the factory, cost 67 fr., so that including for firewood (8.3 fr.), labour and attendance (4 fr.), cleaning, blowing, and blackening the moulds (4.8 fr.), the total cost for the 12 hours was 84.10 fr.

On the other hand, the electrical consumption of the radiator and fan in the same time was 1,200 units, and with energy costing at night 0.05 fr. per unit, the cost of energy was 60 fr., which represented the total cost, as no attendance was necessary, and no outlay was incurred in connection with the moulds, as they were removed from the drying room in a clean condition.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Filbar Electric Boiler.

One of the exhibits at the recent exhibition in Glasgow, and at the Science and Key Industries Exhibition which was held in that city, was the electric water boiler introduced by MESSRS. FILBAR ELECTRIC HEATER, LTD., of 46, Berwick Street, London, W. 1. This is a new device, capable of providing up to a quart of boiling water within one minute, and smaller quantities in a correspondingly shorter time. The boiler is 6 in. in diameter and 16 in. high. When hot water is desired, a valve rod is pressed until a gauge indicates that the required quantity of cold water has been admitted, when it is released; and in due course—after 30 to 60 seconds—the boiling water is automatically ejected. The current cannot be switched on unless water is admitted, and the water cannot be ejected until it is actually boiling.

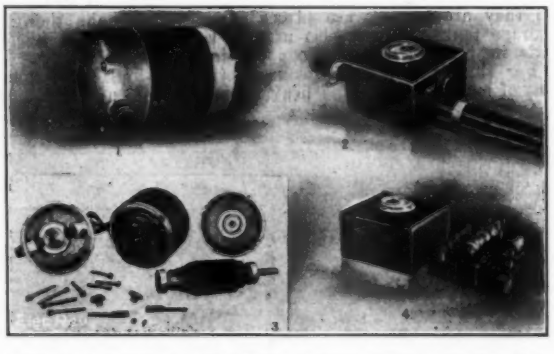
Other exhibits were the Filbar patent steriliser and a small electric heater of the geyser type, which is attached to a water tap; the geyser measures 8 in. high × 2¾ in. in diameter, and when the water is turned on the current is automatically switched on, a continuous flow of water at 120 to 160 deg. F. being obtained.

Electric Salt-bath Furnaces.

MESSRS. AUTOMATIC & ELECTRIC FURNACES, LTD., of 281, Gray's Inn Road, London, W.C. 1, inform us that as a result of lengthy experiments in their laboratory, extending over two years, they have succeeded in obtaining a perfectly non-porous metal container for their electric salt-bath furnaces, which permits the current to be switched "on" and "off" as and when required. The new metal furnace pots are easily replaced by simply lifting the furnace up and removing the pot. With energy at one penny per unit, a ton of tools can be hardened for the small cost of £2 4s. The use of these metal pots is an entirely new departure, and is the subject of provisional protection.

The Perna Motor Cycle Lighting Set.

Judging by the recent exhibition at Olympia, a feature of motor-cycle development is the increasing adoption of electric lighting. To meet the demand a number of new dynamo lighting sets specially designed for use on motor cycles have already made their appearance. Among these is the Perna, made by the PERNA ENGINEERING WORKS, of Castlegate, South Shore, Blackpool. The set, which has been undergoing private tests since 1914, and is stated to have proved entirely reliable in use, comprises the dynamo, switchbox, accumulators, and the usual set of three lamps. Dealing first with the generator, the windings are arranged to give a continuous output of 40 watts at 8 volts; the makers state that it will supply a constant current of one ampere above that taken by two 32-C.P. half-watt lamps and one 4-C.P. tail lamp, when running at a normal speed of 3,000 R.P.M. The armature shaft runs on large double-row, self-aligning bearings, and is arranged to be driven by a Whittle belt or by a chain as required.



FIGS. 1, 2, 3 AND 4.—THE PERNA MOTOR-CYCLE LIGHTING SET.

The overall dimensions of the dynamo are 4 1/16 in. outside diameter, by 5¾ in. over the bearings; the weight is under 10 lb. Fuller block accumulators are employed in connection with the set, and the wiring passes through a switchbox so arranged that it can be mounted on the top tube of the frame of the motor cycle. The switchbox has an ammeter in the top easily visible when driving by night, as when the lamps are switched on a small bulb beneath the ammeter dial in circuit with the tail light acts as a tell-tale for the back lamp. Inside the switchbox is an electromagnetic cut-out which automatically breaks the circuit when the generator speed drops below 800 R.P.M., thus preventing the batteries discharging themselves through the dynamo. Another feature of the set is a half-voltage device whereby the lamps can be run on half-pressure, and the lamps dimmed when the machine is stationary or when riding through fog. One advantage of this arrangement is that only a small current is

consumed, enabling a smaller battery than usual to be employed. Referring to the illustrations, fig. 1 shows the generator, and fig. 2 its component parts; fig. 3 shows the switchbox in position mounted on the top bar of the cycle. Fig. 4 is a view of the switchbox with the cover removed.

The Lesco Lampholder.

In designing the "Lesco" lampholder, Messrs. LESCO, LTD., of Lloyd's Bank Buildings, King Street, Manchester, have struck out a new line. They have abandoned the internal-screwed carrier ring and the spring plunger contacts, both of which have given trouble enough in the past, and have substituted an external ring and solid contacts. The latter are mounted in a block of porcelain, and the leads are directly attached to them, so that there are no sliding contacts; the block carrying the contacts is pressed down upon the lamp cap by a substantial spring, which of course carries no current. The cord grip is also a new departure, consisting of two moulded plates of insulating composition; the leads are passed through separate holes cut at an angle in the upper piece, and then through a single hole in the centre of the lower piece, the slight bend imposed on the wire in doing this forming a perfect lock on the flexible when the holder is assembled. This cord grip requires no cutting away to accommodate the flexible, and will withstand a direct pull of 60 lb. The holder is very easily wired. The shade ring is *outside* the shade, which is secured by one half turn of the locking ring, which is provided on every holder, of which in fact it is an integral part even when no shade is used, locking the two portions of the holder together. To put on the shade, the lower portion of the holder is taken off and the shade is placed in position; the holder is then put together with a bayonet joint, and the locking ring fixed in position, the whole operation taking only a few seconds. The "Lesco" holder is made only in one quality (heavy gauge), and is suitable for ordinary or workshop flexible; it can be had with cord grip or screwed. Being able to carry more current than the ordinary lampholder, it is useful on low-voltage systems.

Siemens Dry Cells.

MESSRS. SIEMENS BROS. & Co., LTD., of Palace Place Mansions, Kensington Court, W. 8, have carried on the manufacture of dry cells at Woolwich for over 25 years, and have therefore accumulated a store of experience in this difficult art. During the war their battery department was extended to cope with the Government demands, and they are now in a position to produce large quantities. They have taken up the

FIGS. 5 AND 6.—SIEMENS REFILLS. FIG. 7.—SIEMENS DRY CELL.

manufacture of pocket lamps, including the cases, some of which are fitted with a neat "cam" switch, the subject of a patent, and are made in a variety of patterns. Fig. 5 shows one of the three-cell refills for a pocket case, and fig. 6 a two-cell refill for the "baby torch" type. It is interesting to note that in order to prevent deterioration in storage, the firm have applied to these small cells their "Inert" patent method of manufacture, which has proved so successful with the larger sizes. Fig. 7 shows one of their ordinary square cells, six N, for large output and strong current, as in the case of small glow lamps, induction coils, telephones, &c.

Roger's Magneto.

A magneto for aero-engines having 12 to 16 cylinders has been developed by the Vita Manufacturing Co., of 730, Williamson Buildings, Cleveland, Ohio, U.S.A. It is described in the *Technical Review* as having no moving wires or revolving armature, puncture-proof condenser, and a hotter spark because of the manner in which the voltage and amperage are built up in the magneto field. The process of impregnating the coils renders them waterproof. They were found to be perfectly dry after submersion in water for a week. The two-pole type for 12 to 16 cylinders gives four sparks per revolution of the rotor, the two-spark type gives eight sparks per revolution, while the Liberty motor types give twelve sparks. In recent Government tests attempts were made to short-circuit the condenser by driving nails into it. The magneto continued to function properly, as it also did after portions had been cut out from the condenser.

LEGAL.

A MUNITIONS TRIBUNAL CASE AT WOLVERHAMPTON.

AT the Munitions Tribunal at Wolverhampton, last week, Mr. Flavell, representing the Workers' Union, called attention to an arrangement made between the union and a Wolverhampton firm of manufacturing electrical engineers, whereby, in settlement of claims made for the payment of arrears of pay under an award applicable to the trade, the firm had agreed to pay the sum of £1,200 for distribution among 168 girls in their employ. The claim was for the payment of arrears of 50 weeks, amounting to 3s. per week for girls over 18 years of age, and 2s. per week for girls under 18 years of age. Mr. Flavell said that his members were quite satisfied with the settlement, and added that the firm had agreed to pay the rates under the award in the future. A representative of the firm stated that they had not been defaulters willingly, as it was only after the case had been referred to the Interim Court of Arbitration that the award in respect of their workers was made.

The CHAIRMAN said that the firm had rendered themselves liable not only to pay the money, but, in respect of every girl, to a penalty of £5 for every day that they had neglected to pay. It was evident that the defendants had committed a series of offences since November 11th, 1918, though he would not deny that they had been placed in a very difficult position owing to the difficulty of interpreting the Act, and the fact that the case had been sent to the Court of Arbitration. It was evident there was no deliberate intention to evade the Act, especially as the Ministry of Labour had given them an answer on the subject which obviously was wrong at the time it was given. In the circumstances, they would inflict a merely nominal penalty of £10.

Electrical Trades Benevolent Institution. — NORTH EASTERN SOCIAL.—On Friday, December 12th, a social evening was held at Tilley's Rooms, Newcastle-on-Tyne, by many ladies and gentlemen interested in the North-East Coast electrical industries. The occasion was organised with a view to helping the funds of the Electrical Trades' Benevolent Institution. Some 300 guests were received by Mr. and Mrs. R. P. Sloan, who acted as host and hostess. The Lord Mayor and Lady Mayoress were present. The reception was followed by a conversazione. Supper was served in the smaller reception room, and dancing commenced at 10 p.m.

Mr. H. W. Clothier, in proposing a vote of thanks to Mr. and Mrs. Sloan, stated that the object of the Electrical Trades' Benevolent Institution was to grant pensions and temporary relief in case of distress to persons who were or had been engaged in the electrical trade as employers, managers, teachers, or on the engineering designs, drawing, sales, or office staff, or in other similar capacities, or to their dependents, in these times of uncertainty. Although the institution had been in operation since 1905, this was the first local event organised for the purpose of collective effort in the North-East Coast District, but it was hoped by the committee that it marked an epoch of local sympathy and activity. It was announced that the occasion had already been the means of introducing seven life members at £10 each, who together with 25 other subscribers and new members would immediately augment the fund by over £100, and it was hoped that new members would come forward to double this achievement; in any case, Mr. R. Robson and Mr. W. Fletcher were to be congratulated for their initiative and work which had brought about such a useful and enjoyable event, and Mr. and Mrs. Sloan had added another token of kindness to their invaluable service to the electrical industry. The funds will further benefit by about £25, the profit left after paying all expenses.

Electrical Heating of Acids. — The heating of acids requires special precautions. The direct immersion of electric heaters in the acid is precluded owing to the fact that there are no suitable materials that will withstand the action of boiling acid. The special heaters described consist of a spiral of wire enclosed in quartz tubes. For high temperatures the spirals are wound of tungsten, while for lower temperatures nickel or nichrome may be used. The spiral touches the inner surface of the quartz tube. The tube is filled with an inert gas, such as hydrogen. Tubes of 1 KW. capacity have an external diameter of 15 mm. and a length of 400 mm. They may be used for all electric heating purposes, and will stand being suddenly immersed in water or liquified gas.—*Revue générale de l'Electricité.*

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

31,268. "Telephones." R. L. MURRAY and TELEPHONE MANUFACTURING CO. December 13th.

31,269. "Electrical cable connector boxes." M. H. GOLDSTONE. December 13th.

31,300. "Acoustic alarms operated by alternating electric current." M. P. FAYRE-BULLE and M. J. LAVET. December 13th.

31,304. "Electrical signalling apparatus for mines, &c." C. HUNTER and F. E. IMESON. December 13th.

31,329. "Sparking plug." F. J. NICHOLLS. December 15th.

31,338. "Electrical terminals of sparking plugs, &c." C. B. BROWNE. December 15th

31,345/6. "Radio-navigational apparatus, &c." H. L. CROWTHER, J. ERSKINE-MURRAY and J. ROBINSON. December 15th.

31,384. "Electrically-driven sewing machines." F. W. LE TALL. (Westinghouse Electric and Manufacturing Co.) December 15th.

31,390. "Electric lighting systems for automobiles, &c." J. S. WITHERS. (Renault.) December 15th.

31,403. "Sparking plugs." B. HOPPS and A. M. LODGE. December 15th.

31,452. "Methods of distribution on alternating-current systems." A. M. TAYLOR. December 16th.

31,472. "Mounting of rotary shafts for electric motors, dynamos, and rotary converters." L. KING. December 16th.

31,478. "Sparking plugs." C. H. BINGHAM. December 16th.

31,500. "Electric relays for signalling." J. J. V. CONNAUGHTON and M. J. RAILING. December 16th.

31,501. "Electric signalling apparatus." J. J. V. CONNAUGHTON and M. J. RAILING. December 16th.

31,511. "Apparatus for use in telegraphy and telephony and control of electrically-actuated apparatus at a distance." A. H. BRANTON and E. A. HINTON. December 16th.

31,519. "Spotlight electric lamps." EDISON SWAN ELECTRIC CO. and P. FREEDMAN. December 16th.

31,534. "Electric lamp holders." A. G. OLIVER. December 16th.

31,561. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. (General Electric Co.) December 16th.

31,569. "Electric switches." R. W. HILLS. December 16th.

31,572. "Telegraphic and telephonic apparatus." H. ST. J. DE A. DONISTHORPE, R. M. RADIO, LTD., and A. WILLIAMS. December 16th.

31,575. "Magneto-electric transformers." P. RABBIDGE. December 16th. (Australia, December 19th, 1918.)

31,578. "Process of welding." WILSON WELDER METALS CO. December 16th. (U.S., October 31st, 1917.)

31,579. "Welded joints." WILSON WELDER METALS CO. December 16th. (U.S., September 14th, 1918.)

31,580. "Manufacture of arc-welding electrodes." WILSON WELDER METALS CO. December 16th. (U.S., July 21st.)

31,617. "Electric welding." O. A. KENYON. December 17th.

31,626. "Means of casting bridge pieces on lugs of accumulator plates, &c." H. DUTTON. December 17th.

31,627. "Insulators for electrolytic systems." A. S. GUSH. December 17th.

31,642. "Apparatus for purification of liquids by electrolytic treatment." A. S. GUSH. December 17th.

31,651. "Electrical signalling and indicating devices for ships, &c." R. S. O'NEIL. December 17th.

31,665. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and F. P. WHITAKER. December 17th.

31,674. "Wireless reception apparatus." H. L. CROWTHER and J. ROBINSON. December 17th, 1919.

31,695. "Apparatus for issuing receipts from electricity meters, gas meters, &c." C. A. GUSTAFSSON. December 17th.

31,710. "Starting, lighting, and ignition apparatus of internal-combustion engines for motor vehicles." N. STELL. December 18th.

31,711. "Electric heat-producing element." C. H. RODDIS. December 18th.

31,712. "Sparking plugs." W. AKED and J. TAPLEY. December 18th.

31,775. "Coin collecting devices for telephone services." A. J. H. HADDAN. (Hall.) December 18th.

31,776. "Meter registers and control devices for telephone services." A. J. H. HADDAN. (Hall.) December 18th.

31,783. "Sparking plugs." A. J. HUDSON and W. H. PEATE. December 18th.

31,786. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and F. P. WHITAKER. December 18th.

31,788. "Mixed electric drive for vehicles equipped with steam turbines, polyphase gengrators, and asychronous motors." MASCHINENFABRIK OERLIKON. December 18th. (Switzerland, October 30th.)

31,789. "Method of controlling polyphase motors on vehicles." MASCHINENFABRIK OERLIKON. December 18th. (Switzerland, November 3rd.)

31,806. "Refillable electric fuses." PERFECT REFILLABLE FUSE INC. December 18th. (U.S., December 18th, 1918.)

31,814. "Treating weakly magnetic iron ore containing sulphides as a secondary constituent." R. JOHANSON. December 18th.

31,815. "Incandescent electric lamps." L. A. DE BECKER. December 18th.

31,832. "Signal lamp." P. PHILPOT. December 18th.

31,834. "Apparatus for electric traction systems." S. MCLEAN and A. MUIR. December 18th.

31,856. "Device for testing sparking plugs." A. V. TERRY and TERRY & SONS. December 19th.

31,876. "Electrically-controlled valves for steam, hot water, gas, &c." G. WILKINSON. December 19th.

31,880. "Telegraph and telephone systems." I. HORTIX. December 19th.

31,891. "Contact breakers for ignition magnetos, &c." F. H. FARRER, F. POUNTNEY, and VILLIERS ENGINEERING CO. December 19th.

31,895. "Medical electrical light and heat treatment couch." H. J. MOUSON. December 19th.

31,898. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and C. A. MARTIN. December 19th.

31,899. "Electric furnaces." BRITISH THOMSON-HOUSTON CO. and H. C. HASTINGS and N. LAYCOCK. December 19th.

31,920. "Electric switchboards." A. J. MIDGLEY and C. A. VANDERVELL & Co. December 19th.

31,927. "Enabling movable objects to pursue an electrically staked-out route." A. W. LOTIS. December 19th.

31,940. "Telephones." C. KEARTON and G. B. RILEY. December 19th.

31,942. "Electric lamps." EDISON SWAN ELECTRIC CO., P. FREEDMAN and G. A. PERCIVAL. December 19th.

31,948. "Ignition devices for internal-combustion engines." F. A. SMITH. December 19th.

31,953. "Switches for electric lamps, &c." J. B. PORTWAY. December 20th.

31,966. "Sparking plugs." G. WILSON. December 20th.

31,975. "Spot welding machines." F. A. CRAMER and H. MARRYAT. December 20th.

31,976. "Seam welding machines." F. A. CRAMER and H. MARRYAT. December 20th.

32,013 "Sparking plugs." E. CHASSERAUX. December 20th. (France, January 14th.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

11,785. VARIABLE ELECTRIC RESISTANCES. W. E. Baker. January 18th, 1918. (135,523.)

1918.

6,856. HIGH-TENSION ELECTRIC TRANSFORMERS. F. Dessauer. April 23rd, 1918. (135,528.)

12,968. MAGNETO-ELECTRIC MACHINES. B. Wolkoff. August 9th, 1917. (118,620.)

13,752. ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co., H. W. Taylor, F. H. Clough and F. P. Whitaker. August 23rd, 1918. (135,533.)

14,315. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. and A. A. Pollock. September 3rd, 1918. (135,534.)

15,529. ELECTRICAL IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Remy Electric Co. September 19th, 1917. (120,203.)

15,769. X-RAY APPARATUS. M. B. Rodriguez. September 27th, 1918. (135,540.)

19,326. UTILISATION OF WIND POWER FOR THE GENERATION OF ELECTRICITY. H. J. Read. November 23rd, 1918. (135,573.)

19,595. FILAMENTS FOR ELECTRIC LAMPS. Westinghouse Lamp Co. February 19th, 1917. (121,596.)

20,279. CIRCUIT ARRANGEMENTS FOR REDUCING STATIC INTERFERENCE IN RADIO-RECEIVING STATIONS. Western Electric Co. (Western Electric Co.) December 6th, 1918. (135,635.)

20,289. ELECTRIC SELECTORS FOR TELEPHONE SYSTEMS. C. A. W. Hultman. December 11th, 1917. (121,474.)

20,378. ELECTRIC METALLURGICAL FURNACES. W. E. Moore. December 7th, 1918. (135,639.)

20,828. SPARKING PLUGS. T. Antoine. December 13th, 1918. (135,661.)

21,052. HIGH-TENSION INSULATORS FOR USE IN ELECTRIC SUPPLY SYSTEMS. J. E. Pollak. (Fabbrica Isolatori Livorno.) December 17th, 1918. (135,667.)

21,307. INSULATORS FOR HIGH-TENSION ELECTRIC CABLES. H. Wade. Fabbrica Isolatori Livorno.) December 19th, 1918. (135,669.)

21,562. ELECTRIC TIME SWITCHES. E. A. Fagerlund. December 23rd, 1918. (135,672.)

21,644. ELECTRIC SWITCHES. L. Benvenuti and G. Cigolini. December 24th, 1918. (135,673.)

21,863. ELECTRIC FURNACES. E. Waring and W. Waring. December 31st, 1918. (135,674.)

1919.

1,737. ELECTRIC STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. H. Lucas, C. L. Breeden and H. W. F. Ireland. January 23rd, 1919. (135,695.)

2,742. HIGH-TENSION DISTRIBUTORS FOR ELECTRIC IGNITION APPARATUS. Akt. Ges Brown, Boveri et Cie. February 4th, 1918. (Addition to 114,825.) (123,086.)

5,621. ELECTRIC LIGHT FITTINGS. F. Rawcliffe. March 6th, 1919. (135,734.)

8,560. ROTORS FOR DYNAMO-ELECTRIC MACHINES. P. F. Brittain. April 4th, 1919. (135,747.)

10,932. APPARATUS FOR LAMP SIGNALLING IN OVERHEAD WIRE SYSTEMS OF ELECTRIC TRACTION. Brecknell, Munro & Rogers and A. M. Willis. May 2nd, 1919. (135,764.)

13,201. ELECTRIC FIRES. H. H. Berry. May 26th, 1919. (135,779.)

14,427. ELECTRIC RAILWAY SYSTEMS. Metropolitan-Vickers Electric Co. July 10th, 1918. (129,628.)

14,934. CONSTRUCTION AND DESIGN OF BASES, CONTACTS, AND SOCKETS OF WIRELESS VALVES OR VACUUM TUBES. J. W. Polybank. June 13th, 1919. (135,792.)

16,916. ELECTRICAL MEASURING INSTRUMENTS OF THE MOVING COIL TYPE. G. T. Garwood. July 5th, 1919. (135,801.)

17,622. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. C. M. E. L. Monnier. July 13th, 1918. (129,985.)

18,678. ELECTRIC LIGHTING OF MACHINES DRIVEN BY ELECTRIC MOTORS. V. Hope. March 21st, 1918. (Divided application on 4,990/18.) (135,150.)

21,025. TELEPHONE SWITCHBOARD AND PLUG FITTINGS. Naamlooze Venootschap de Nederlandsche Thermo-Telephone Mattschappij. August 27th, 1918. (131,895.)

21,866. SPARKING PLUGS. F. A. L. Johnson. September 5th, 1919. (135,184.)

23,540. APPARATUS EMPLOYING VARIABLE ELECTRIC RESISTANCES. S. G. Brown. August 13th, 1918. (Divided application on 13,167/18.) (135,157.)

Water Power.—Mr. Lloyd George, on December 30th, visited Dolgarrog Aluminium Works, near Bettwsycoed, and the North Wales Power Co.'s Works. The Prime Minister was accompanied by Mrs. Lloyd George, Sir George Riddell, and Mr. and Mrs. Richard Lloyd George, and was entertained at luncheon by Mr. Jack, managing director of the companies, and the heads of the various departments. Replying to the toast of his health, Mr. Lloyd George said that he had long intended to visit those works, as he was specially interested in the regeneration of country life. For hundreds of years millions of gallons of water had been running to waste. We were the most backward nation in the utilisation of water-power. In Germany water-power had long been made use of for factories, agriculture, and other purposes, with the result that remote communities had been established which were rendering valuable service to the community at large. He hailed the advent of similar enterprises in this country. The secret of the future lay in the adequate exploitation of our great natural resources—coal and water. In other words, cheap power was the great necessity of our manufacturing life.